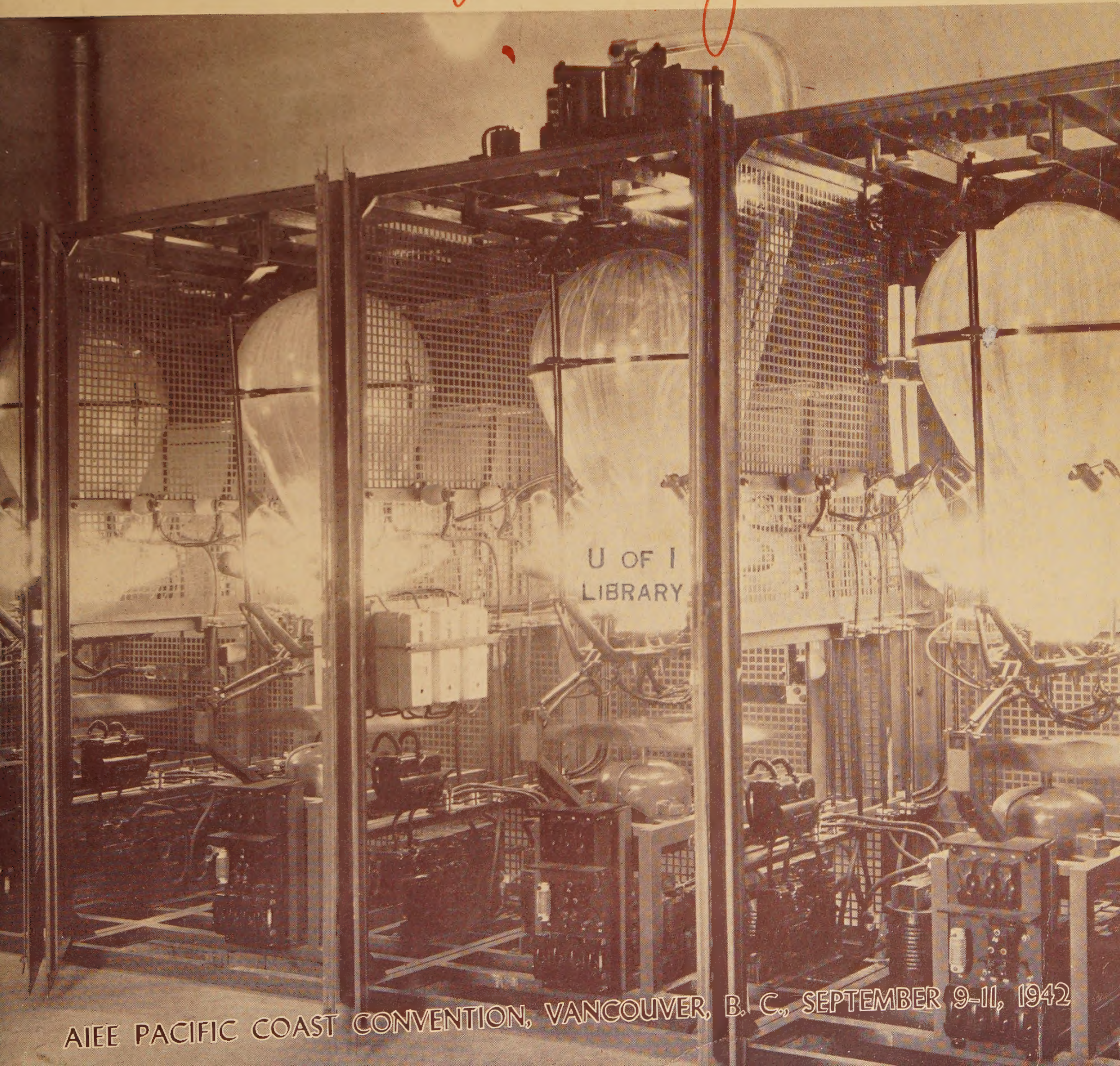
ELECTRICAL ENGINEERING

AUGUST 1942

Noel J Litucky



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AUGUST
1942

The Cover: Glass-bulb mercury-arc traction rectifiers at one of the substations of the British Columbia Electric Railway Company, Vancouver, may be inspected during the forthcoming AIEE Pacific Coast convention, to be held at Vancouver, September 9–11, 1942.

TRANSACTIONS SECTION

(Follows EE page 446; a preprint of pages 539–622 of the 1942 volume)

G. Ross Henninger
Editor

Floyd A. Lewis
Associate Editor

F. A. Norris
Business Manager

C. A. Graef
Advertising Manager

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HIGH LIGHTS • •

Protection Against Lightning. Data on properties of natural lightning have been obtained by observing damage by lightning strokes to thin metal surfaces and evaluating from laboratory tests the characteristics of the lightning causing the damage (*Transactions pages 559–64*). Analysis of abnormal currents in distribution transformers has shown that under certain conditions of direct stroke, excessive currents may wreck the secondary windings; long-duration surges or shorter repeated surges saturate the transformer cores, producing greatly increased surge currents in the primary windings (*Transactions pages 564–8*). In installing buried counterpoise for lightning protection of transmission lines, installation of an arbitrary length of conductor at each location and estimating the additional amount required from measurement of the ground resistance of the trial location have been found to be a more practical procedure than striving for the values of footing resistance indicated by the accepted formulas (*Transactions pages 599–603*). Developments in testing technique for lightning arresters have resulted in a high-voltage cathode-ray oscillograph of the cold-cathode type with the film in the evacuated chamber (*Transactions pages 549–53*) and simplified methods of calculating approximately the impulse-generator circuit constants required to produce specified waves (*Transactions pages 539–44*).

Ignitron Rectifiers. Sealed ignitron tube rectifiers, ranging in capacity from 75 to 400 kw per unit, with d-c output potentials of 250 to 600 volts, have been installed to supply d-c power for various types of industrial loads (*Transactions pages 594–9*). For excitation of ignitron rectifiers, static magnetic-impulse circuits have been preferred in many cases; ignitor requirements and tests for measuring excitation-circuit capacity have been described for three such circuits (*Transactions pages 574–7*). Basic analytical methods have been developed to aid in establishing load-cycle ratings of ignitron rectifiers, by applying a general method applicable to various types of apparatus to specific conditions encountered in ignitrons (*Transactions pages 545–8*).

Rating Electric Apparatus. A review of the ambient-temperature values now used for rating electric apparatus has indicated the desirability of clarification in methods. For apparatus rated on the basis of an ambient of 40 degrees centigrade, appreciable margins in permissible temperature rise have been found to exist under many conditions (*Transactions pages 553–8*). Since electronic devices are used extensively with intermittent loads, such loads have been especially considered in the assignment of ratings for these devices, and methods of rating that seem to be generally applicable to many tubes and tube arrangements have been suggested (*Transactions pages 569–73*).

The Engineer, the War, and the Peace. The engineering genius that has developed under democracy will provide our armed forces with the weapons they need—"enough and on time," a prominent engineering educator declares (*pages 402–04*). Not only are we now fighting an engineers' war, but engineers are already drawing the blueprints by which the army now fighting a war in factory and field will be converted to winning peace and prosperity, according to Retiring AIEE President Prince (*pages 393–6*).

D-C Moving-Magnet Instrument. A d-c instrument developed as a battery-testing voltmeter has characteristics, obtained by the use of new permanent-magnet materials, that make it an acceptable substitute for a permanent-magnet moving-coil instrument of normal sensitivity (*Transactions pages 586–8*).

Uses of the Carbon Arc. The carbon arc, a versatile source of both visible and invisible radiation, is adapted to various types of commercial and industrial operation, including processes which require specific bands of ultraviolet radiation or close reproduction of the effects of natural sunlight, and applications necessitating a light source of small area and extreme brilliance (*Transactions pages 581–5*).

Fluorescent-Lamp Electronics. Of the two energy converters connected in series, which constitute the fluorescent lamp, the first, a gaseous conductor that converts electric energy into ultraviolet radiant energy, is an electronic device; the second is the coating of fluorescent powder that acts as a frequency changer to convert ultraviolet radiation into visible light (*Transactions pages 607–12*).

Impregnated-Paper Insulation. Most recent of a series of studies of the breakdown strength of impregnated paper shows a marked decrease of dielectric strength with increasing paper density; results also showed the dielectric strength to be higher when the paper is impregnated with thin rather than heavy oil (*Transactions pages 618–22*).

Correction. Price of the June 1942 Supplement to Electrical Engineering—Transactions Section, now available, was incorrectly stated in the July 1942 issue of *Electrical Engineering* (page 360) as $1 outside the United States and United States possessions. The price is 50 cents per copy to Canada and other countries as well as the United States and its possessions.

Electric Control of Locomotive Boiler. On steam boilers of electric and Diesel-electric locomotives, the electric controls needed for efficient, safe, and uninterrupted operation may be automatic or semiautomatic; some are required by operating necessities and others by safety regulations (*Transactions pages 604–06*).

Rectifiers for Telephone Offices. Various types of thyratron-tube self-regulating rectifiers are described in this issue, including two types which by electronic means control the output current of thyratron rectifiers by the voltage applied to the grids to regulate the output voltage (*Transactions pages 613–17*).

A Look at Engineering Education. A canvass among engineering educators and employers of engineering graduates revealed some interesting opinions on the objectives of engineering education—what they are or what they should be; these are surveyed as a basis for reformulating educational aims to serve a changing society (*pages 406–14*).

Rectangular Tubular Conductors. Formulas have been derived from which can be calculated the short-circuit stresses in the supports of single-phase or polyphase a-c or d-c busses made up of identical strap or rectangular tubular conductors with parallel coplanar axes (*Transactions pages 578–80*).

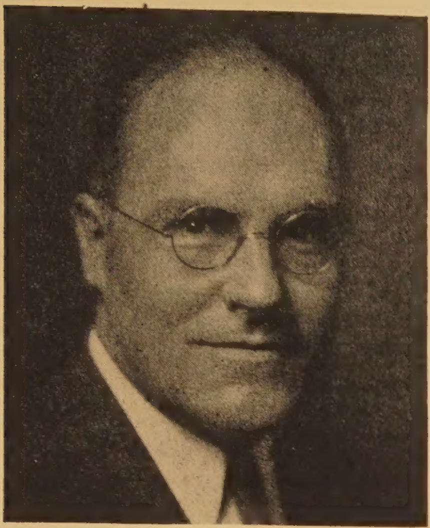
Sleet on Electrified Railroads. Electrified railroads operating with overhead contact systems have ice-storm problems similar to those confronting power companies, and a number of special problems peculiar to the railroads (*Transactions pages 589–93*).

Lamme Medal. Presentation of the 14th AIEE Lamme Medal during the summer convention at Chicago provided the occasion for inspiring surveys of the careers of both the founder and the 1941 recipient, Forrest E. Ricketts (*pages 396–401*).

Summer Convention. For the benefit of the Institute members who could not be present in person, the Institute Activities section of this issue is largely devoted to a "summer convention in type" (*pages 417–32*).

Coming Soon. Among special articles currently in preparation for early publication in *Electrical Engineering* are: an article on quality control in connection with war production by Lieutenant Colonel L. E. Simon; an article on powder metallurgy by F. C. Kelley; an article discussing various aspects of the electromagnetic field by Leigh Page; an article on the engineer and the engineering method by A. R. Gruehr (M'30); an article describing the training provided in a modern technical high school by C. E. Crofoot (M'28).

The Engineer's Last in the Postwar World



DAVID C. PRINCE
PRESIDENT AIEE, 1941–42

The engineer's last, to which he must stick if he is to make the maximum contribution to the postwar world, is defined by Retiring President Prince as working out the plans for a peacetime production of goods and services comparable to our wartime production, which would provide "not merely sustenance and military protection, but comfort and security for our entire population."

APPELLES, the court painter to Philip of Macedon, was exhibiting one of his portraits. A shoemaker criticized him for representing a shoe with one latchet too few, and Appelles corrected the error. The shoemaker was delighted at having his advice accepted and added a criticism of the manner in which the leg was painted. But this was too much for Appelles, who broke out, "Let not the shoemaker judge above his shoe."

The engineer of today is in much the same position as this shoemaker. The shoemaker's advice was taken once. The engineer's advice has been taken many times. The war which we are now fighting is an engineer's war.

When this war is over the engineer will have a large part in the attempt to construct a peace free from the faults of the peace made at Versailles; but like the shoemaker of old—400 B.C.—he must stick to his last. He is the man who understands all the processes from mining through design and manufacture to application of a finished product. He is the man who knows how to build a Grand Coulee dam by attention to details that range from the sample borings for the foundations to the feeding and housing of the workmen. He is one of the specialists of our civilization, but like any specialist he has his limitations. He must keep from overreaching himself, as the shoemaker did, by seeing just what his most valuable contribution to our postwar world can be.

The material resources of the United States and our knowledge of production are enabling us to make $60 billion worth of products for war this year, in addition to what we need to keep alive—to produce, in fact, a total of $115 billion worth. We could produce a comparable amount of goods and services in a peace year, and that would provide not merely sustenance and military protection, but comfort and security for our entire population. Working out the plans for this job is our engineer's last.

The broad features of the problem must be seen first. Our productive resources in men and machines must be ascertained. The war-production picture is known. It can be presented in as much detail as necessary. The outline of a peace program that we should like to create, and can create, after the war—this can be seen in the same way. It can be worked out in as much detail as is necessary at this time.

The picture of war production is the picture of an existing reality; but the picture of peace production is not. To make it real we must solve the problem of reconversion after the war is over. If we do not bridge the gap between war and peace, we may have from 25 to 30 million people unemployed for an indeterminate time.

At present a record number of people are being employed at high wages. They will have money to spend when the restrictions upon spending are lifted, and they have desires to buy things—desires that existed long before the war. This combination of the power to spend and the desire to spend can create an era of plenty.

To an economist it is a truism that purchasing power and production are equal. It is not true, however, that those goods the production of which creates purchasing power will automatically be bought by that purchasing power. The accommodation of production to purchasing power must be planned, and the planning is a job requiring engineering methods. It is a job for many engineers, not for just one, or even a few.

Essential substance of president's address delivered at the annual meeting during the AIEE summer convention, Chicago, Ill., June 22–26, 1942.

David C. Prince, is vice-president in charge of application engineering, General Electric Company, Schenectady, N. Y.

Full employment after the war will make possible a total production of $110 billion in terms of 1940 dollars. At the present ratio of wages to prices, wages and salaries will amount to about $68 billion, which with the incomes of farmers and professional people will produce a consumer market of $77 billion.

Much of this market, of course, will not be affected by the transition from war to peace. Soldiers, when they become civilians again, will eat the same kinds of food that they eat now, and their clothes will be made of the same materials. Aluminum and steel sheets are the same for war or peace. Automobiles, refrigerators, and radios, however, are at present out of production, and from nine months to a year will be required to get them back into production, even if reconversion is well planned. If it is badly planned, the time will be much longer.

Again, if the reconversion is well planned, automobiles, refrigerators, and radios will appear in about the right proportion. If the planning is poor, there will be too many automobiles and too few refrigerators. This is dislocation of industry, and unemployment is the result. The purchasing power of displaced employees falls; with it the demand as a whole falls further; then more men are thrown out of work, and so on. The effect is cumulative. Yet this trouble can be avoided if the engineers of our industrial concerns will undertake the problem, first of apportioning production, then of planning the details of conversion, in such a way as to produce the desired volume of production.

The engineers of raw and semifinished materials will gear their production to the requirements of those making the finished product, as will the makers of tools. Power-company engineers will survey the power needs of industry and have the kilowatts ready.

Some of the smaller manufacturing companies do not possess the technical staffs required to convert their plants from peace to war. As a result, they are suffering from a lack of war orders which no amount of political pressure can remedy. When the time comes for reconversion, they will be even worse off. These small concerns will find their prewar products outmoded by war developments. They will not know what to make, or how to make it.

This is an opportunity for the consulting engineers. They can determine first which products are scarce, and which are too abundant. Then they can survey the field to see what locations are best adapted to produce those goods of which more is needed. Lastly they can design up-to-date, efficient factories to make their clients better able to compete with the firms which progressed during the war.

The opinion has been expressed that the postwar era will be one of intense competition. It is to be hoped that this will be true, but in a healthy sense—that each producer will be competing to achieve the highest efficiency, to pay the highest wages, and still to deliver the lowest-cost product. Unhealthy competition will result if too many producers crowd into a small section of the market, competing for survival where there is not enough purchasing power to go around. Yet the fact that total purchasing power must be equal to total production shows that there must be a market for all if the production is correctly apportioned.

The factories that will require consulting aid include those now making explosives and other things having either no peacetime uses, or greatly reduced peacetime uses. It is to be hoped that these plants can be kept in running order to be ready for another war, should one come. There is no better insurance against the next war. Some of these plants are located apart from the existing towns and have been created new with all their homes and services. New industries suitable for these communities should be found. Excellent organizations and the general services, such as light, heat, water, sanitary and even recreational facilities, are already in existence in the new towns. Opportunities exist to use them to keep the population available for future war production.

Much has been said of public works as a flywheel for business. But the engineer, sticking to his last, is trying to avoid those business fluctuations that require a flywheel, and regards public works as merely one kind among all the kinds of things required by the community. The constructional features of public works, and their planning, are right down his alley. Every community has so many factories or mercantile establishments to serve the neighboring farms. These require services in the form of water sewers, streets, parks, schools, hospitals, and residential areas. All of these should be scientifically proportioned, and plans for them made ready to carry out. The volume of such projects released in any year should be such as to keep a building industry of reasonable size occupied. Many kinds of engineers will work upon phases of this problem.

The prosperity of any community depends upon a reasonable balance within its market area. A nation must have enough exports to pay for its imports. If it has too few exports in comparison to imports, it goes broke If it has too many, it has to give the surplus away. Similar situations confront regions or towns. For every community the problem is whether it is putting its productive activities to the best possible use. The task of the engineers in every community is to work together in surveying this problem, and finding solutions for it.

Emporia, Kans., for instance, has suffered a decrease in population because it has few industries, and no war industries. Has the drift of people away from Emporia gone as far as it will? Do the citizens of Emporia want it to remain an agricultural marketing center and college town?

Wichita, Kans., is a boom aviation town. Present estimates indicate that its postwar commercial-aviation

manufacturing will be about one fourth the present volume. How much of the permanent aviation manufacturing business is Wichita's share, and what is the most profitable activity for those left over? San Diego, Calif., is like Wichita, with the naval base added in for good measure. Neither is a source of raw materials, except farm products.

Seattle, Wash., however, is in the heart of the timber country. It is in a region of recurrent showers, which do not favor the aircraft industry. Yet, if plastic bonded plywood is to make the civilian airplane of the future, Seattle is better adapted than either Wichita or San Diego to maintain an aviation industry.

In California and in Texas natural gas is plentiful. Neither of these states yet has the industrial development to make full use of this cheap source of power, although some progress has been made during the war.

Detroit, Mich., has seen large factories built to make tanks and other war material. These are outside the city limits and call for general rearrangement of transportation and residential areas.

The future well-being of the United States demands that engineers work out solutions to these problems, with full employment of the local labor force as the central objective. In our war effort we are learning that the only real limitation to production volume is the available labor force.

The solution of a local industrial problem is never complete or independent of problems elsewhere. The suburbs of a city must be considered with the city. The division of the country into Federal Reserve districts is a realization that it consists of marketing regions, each of which is an organic whole of interdependent parts. Many statistics are kept on a Reserve District basis. The industries in one of these districts are interrelated. Therefore, local engineering councils logically should send representatives periodically to Reserve District conventions, there to thresh out problems which involve more than one town or city.

There will still be national problems left to be treated by a national representative gathering. All this planning, however, should have a "grass roots" foundation. The local people must first make up their minds as to what their locality requires. The local plans can then be freed from their conflicts by representatives of Federal Reserve or other logical areas and finally the national total can be cast up. In that way we can have the maximum amount of local freedom of initiative, and at the same time some assurance that the parts will add up to a total of full employment and output.

The solution of all these problems is the engineer's last. Perhaps AIEE members will say, "Good Lord! We are only electrical engineers. You can't expect us to know much about things like making airplanes out of plywood." Yet remember that there are many, many different kinds of engineers to solve these different problems. In trying to make up programs for AIEE conventions—gatherings of electrical engineers only—one is impressed by the variety of subjects necessary to keep *our* membership interested. The American Society of Mechanical Engineers has many more divisions than we and the total list of engineering societies is constantly growing. Each society is responsible for part of the shoe, so to speak, and all must work together if the complete job is to be done.

How does the engineer make his shoe fit the last? He must work with the facts. Market surveys to determine the size of demand consist of observation of purchase habits and the densities of population. Mining is directed by test drilling. Circuit breakers, iron plate—materials of all kinds are made and tested in accordance with specifications. Designs are made to accomplish specific results, and it is a matter of test and measurement whether the proper results are achieved. We deal in theories, but they must be demonstrable. If they are not, they become mere speculations, and have no more meaning to us than theories about the number of angels that can stand on the point of a needle.

Again, in making his shoe, the engineer is resolved that whatever he does must have some practical and useful effect. Some scientist may be content to study the movement of the stars in their courses. He may be able to predict an eclipse—yet the eclipse will occur, even if he does not predict it and knows nothing about it. What's more, nothing he does can stop it. His occupation is purely a search for knowledge. The engineer must have action. His knowledge must be the means to an end which lies within his power to accomplish. He may acquire knowledge of astronomy, as our scientist does, but he intends to use it immediately, for example in navigation. If he observes rainfall, it is to provide a spillway big enough to carry it off, or a power plant to produce a determined amount of firm, or peak, power. The factory that he plans is to be built to make some product at a cost that has been calculated beforehand.

The engineer is not required to have even an opinion as to whether our postwar world will be totalitarian or democratic, communistic or capitalistic There will be much the same things for him to do in any of these possible worlds; for his world is governed by physical laws, or by economic laws, or by the laws of human nature. If he feels that our free-enterprise system is best, his strongest argument is to make it work superlatively well.

Industry is carrying on now, breaking records in war production every day in spite of a barrage of irrelevant criticism and miles of red tape. Was it right, for example, to secure patent rights to German processes for hard cutting materials and synthetic rubber? Such questions only distract engineers from present problems of production. They may be likened to the razzing of the spectators at a baseball game. The engineers must stick to their business—their last.

In making his shoe the engineer does not worry about

what *may* happen so much as about what *can* happen. If he builds a bridge, he knows that it *may* be blown up by enemy bombs or that it *may* become useless because the main highway over it has been rerouted. But he knows that it *can* carry the load which it ought to carry, and he builds the bridge. A project economically sound may be rendered unsound by changes in the laws, in tariff rates, in the rate of interest, or by a revolutionary new invention, but these further considerations are the concern of someone else. The engineer acts on the basis of present facts. For the future he must act, to some extent, on the basis of assumed facts. Then, of course, his actions are tentative; the findings are qualified by facts to be ascertained later. But all the things that *may* happen, the considerations that lie beyond the field of knowledge of some particular engineer, are to that engineer as the leg which Appelles had painted was to the simple shoemaker. We must let Appelles worry about the leg.

The engineer's job takes time. Surveys cannot be made overnight. Designs take time. Construction plans take time. Tooling takes time, as we all know from our experience in converting our factories to war production. The plans for conversion from war to peace must be begun soon enough for plants to be ready to receive soldiers and sailors home from the war, to receive industrial workers no longer needed in powder mills and tank factories. The time factor must be reckoned in the equation. It is part of the last.

Engineers make designs and plan production of war material undeterred by questions of who will win, or when. They close their ears to the attacks of politicians or fifth columnists. They refuse to get drunk either on the defeats or on the victories. Production must go on at a steadily increasing pace.

The war will be over some day. The engineer does not know when. He does know that some day he will have to turn the army now fighting a war in the factory and in the field to winning peace and prosperity. He is already drawing the blueprints for that conversion. This is not inconsistent with the war effort; for the war job and the peace job are the two halves of the one big job that faces us all.

Every one of us has a shoe to make, and a last to make it by. Let us stick to our lasts.

Forrest E. Ricketts—1941 Lamme Medalist

AWARDED annually for "meritorious achievement in the development of electrical apparatus or machinery," the AIEE Lamme Medal was conferred for 1941 upon Forrest Eugene Ricketts (A'16), vice-president of the Consolidated Gas Electric Light and Power Company, Baltimore, Md., at the recent AIEE summer convention at Chicago, Ill.

The presentation ceremonies were opened by C. A. Powel (F'41) for the Lamme Medal committee, who said, in part:

"This annual recognition of outstanding work was made possible by a bequest made by the late Benjamin Garver Lamme, chief engineer of the Westinghouse Electric and Manufacturing Company, to provide for the award by the Institute of a gold medal, the recipient being selected by a committee of nine members.

"Benjamin Garver Lamme was born near Springfield, Ohio, in 1864. He grew up on a farm, received his early education in the country schools, and went from there to Ohio State University, from which he was graduated in 1888 with a degree of mechanical engineer. Early the following year he entered the service of the Westinghouse company at Pittsburgh, and a few months later began his career as a designer of electric machinery. His success in this field was phenomenal, covering as it did pioneer work in d-c generators and d-c railway motors, single and polyphase a-c generators, turbogenerators, synchronous converters, induction motors, and single-phase railway motors, on all of which his engineering skill left a permanent mark.

"Mr. Lamme was recognized as the outstanding electrical designer of the Westinghouse company almost from the time he began his work, and was chief engineer of the company for many years prior to his death in 1924. His technical papers, some of which have become classics, are remarkable examples of the presentation of technical matter in clear, understandable, nonmathematical language.

"In spite of his modest and retiring disposition, which caused him to shun publicity, his ability was widely recognized and he was awarded the Edison Medal in 1918 for 'invention and development of electrical machinery.' He also received the first award of the Joseph Sullivant Medal, which is awarded at five-year intervals by Ohio State University to the alumnus who has made the most notable contributions to 'the liberal, the fine, or the mechanic arts.' He was a member of the Naval Consulting Board during World War I.

"On the obverse of the Institute's Lamme Medal, accompanying the portrait of the donor, are the words: 'The engineer views hopefully the hitherto unattainable.' These words are taken from one of Mr. Lamme's ar-

ticles and are all the more appropriate in that they aptly characterize his own attitude.

"The reverse of the medal represents Niagara, the birthplace of large scale hydroelectric power, where are installed the great electric generators which Lamme designed. In the background is a modern industrial city, symbolic of the new civilization made possible by electric power."

The achievements of the medalist were described by Nicholas Stahl (F'13) chief engineer, Pennsylvania Power and Light Company, Allentown, and the medal was presented by President David C. Prince. Essential substance of Mr. Stahl's address and Medalist Ricketts' response follows.

AIEE Lamme Medal

Career of the Medalist

NICHOLAS STAHL, Fellow AIEE

Benjamin Garver Lamme *is* a great engineer. The present tense is used with intention, because, whatever one's belief in immortality, there can be no doubt that his spirit lives with us in the bequest of his substance and the inspiration of his mind. So well expressed by the Lamme Medalist of 1938, Marion A. Savage, who said, "All engineers who have to design electrical machinery honor the name of Benjamin G. Lamme, who did so much to advance the designing art. It was my good fortune to know Mr. Lamme personally. His kindly nature, remarkable memory, and keen mind were an inspiration to a young engineer."

A sidelight on the character of Mr. Lamme, out of my own experience, is a clear index of the way the mind of the man approached any problem, no matter how trivial, with the viewpoint of an engineer. One night, many years ago, Mr. Lamme, Norman A. Storer, the Lamme Medalist of 1939, and I were returning from New York to Pittsburgh and, for exercise, were walking to the station. This was before anyone had much more than dreamed of air conditioning. As we passed a candy shop, Mr. Lamme suddenly darted in and in a moment or two returned with a little brown paper bag.

Mr. Storer said, "Why Mr. Lamme, I didn't know you were so fond of candy," to which Mr. Lamme replied, "I'm not. I never eat it."

"Then why the bag?" said Mr. Storer.

Mr. Lamme rejoined, "This bag contains little mint-flavored disks of sugar about one-fourth-inch high and about large enough in diameter to fit into the groove of a window casing. I am a rather sound sleeper, and catch cold rather easily. Before I retire, I raise the window and close it down on about a dozen of these little disks. Then when the rain comes, it melts the sugar; the window drops; I don't wake up; and I don't catch cold."

The Lamme Medalist of 1941 is Forrest Eugene Ricketts. It should be—and in this instance it certainly is—a pleasure to be given an opportunity to describe the worthwhile achievements of any man, particularly when he is of one's own profession. Berton Braley has so well caught the spirit of this thought that I interject a line or two:

> "If with pleasure you are viewing
> Any work a man is doing
> If you like him, if you love him, tell him now;
> Don't withhold your approbation,
> Until the parson makes oration,
> As he lies with snowy lilies on his brow."

Friendship for over 30 years with the Lamme Medalist of 1941 makes the present assignment enjoyable indeed. Contact with a man over so large a span of his life—especially his working life—improves the perspective on his performance. Historians tell us it takes the lapse of a generation, sometimes of a century, properly to appraise the work of a man. This instance embraces a full generation of association. It brings to the account also somewhat of the credibility of an eye witness.

From the very beginning of and all through my contacts, Mr. Ricketts, in exposition of and argument for his ideas with other engineers, ever exhibited qualities basic to his character—consideration, tolerance, politeness, perspicacity, and perseverance.

Forrest Ricketts is a son of Maryland, a son of the soil of Montgomery County, vintage of 1878. He was not only born on the farm, reared on the farm, but remained on the farm until he was 24 years old. He attended Rockville public schools and academy, Columbian (now George Washington) University, and was graduated from Bliss Electrical School, where his laboratory reports were graded "excellent." In June 1942 the University of Maryland conferred upon Forrest Ricketts the honorary degree of doctor of engineering.

He first conceived the idea of entering upon an electrical career when, knee-deep in snow drifts and watching workmen clearing railroad tracks for the passage of trains, he was struck by the chance remark of his brother-

in-law that, if he ever had a son, he'd want him to study electricity.

Ricketts' first job in the field of practical electricity was with the Newport News and Old Point Railway and Electric Company as lineman and wireman. Later he was with the Philadelphia Mining Company of Chloride, Ariz., in the same capacity; with the Los Angeles Pacific Railway and Electric Company, as electrical repairman; and then with the Potomac Electric Power Company as working foreman of electrical construction. From the last-named company he was fired, with the statement that "Ricketts would never amount to anything." How prophetic of today!

In 1905, Mr. Ricketts joined the Consolidated Gas Electric Light and Power Company as an electrician. Since that time he has been chief operator, superintendent of electric stations, and director of intersystem power utilization bureau, and at present is vice-president of the company.

Forrest Ricketts is one of the early workers in the field of distribution of electric power, making contributions that have been in daily use for many years, and bid fair to be used for many more. While he did not attempt to patent all his novel ideas, it is clear that for the most part his 16 patents arose directly from problems solved in the course of his work. His clear recognition of the nature of the problem was largely responsible for his success.

He is often referred to as "the father of selective-relay protection," for he realized early the shortcomings as well as the basic advantages of the induction relay and, to remove the one obstacle to its extensive use on more complex systems, invented the "compensating coil," latterly known as the "torque compensator." In his own words, "Whenever I found something going wrong, or anything that needed improvement, I devoted all my time and energy to trying to work out something to improve those conditions."

GROWTH OF UTILITY INDUSTRY

If we had experienced through the years only the increases in the use of power for lighting and appliances, refrigeration and farming—even its use by the small industrial customer, the growth of the electrical industry would have been tremendously retarded. But as the industry grew, and the value of electricity as a servant began to be appreciated by more and more different kinds of heavy industry; when it was realized that electricity was about the most flexible, dependable handmaiden that could be found for the thousands of different kinds of applications that have since been made; when it was recognized that great progress had been made in the building of ever bigger and better, more efficient generating equipment, transformers, and apparatus for transmitting energy over long distances—then it also began to dawn upon engineers that the very extent of these developments was introducing certain problems that tended to work against the extension of electric service from generating station to remote industrial plant.

CONTINUITY OF SERVICE

These problems largely centered around the occurrence of interruptions. For certain industries, interruptions for even a few cycles are very serious, oftentimes spoiling a considerable part of the product; sometimes not only spoiling the product, but making it necessary to spend some days in getting ready to start production again.

This condition was not confined to plants served from a public utility—interruptions also occurred with companies which had their own generating plants, but in such cases at least, a plant was not subject to the interruptions that occurred as the result of the exposures of transmission and distribution lines of large extent.

For this reason, many concerns for years would not connect with utility systems or buy large blocks of power from them, and did not do so until they were satisfied with the progress in controlling the supply of energy so as to give dependable service of high continuity. That continuity of service was largely accomplished by perfecting the speed and selectivity of protective relaying and achieving quicker reclosure of circuit breakers. It was in precisely these directions that Ricketts made such great contributions. It is his kind of contribution, therefore, that has favorably influenced—in fact largely determined—the growth of big systems. Consequently, today many private industries have found the service of public utilities so satisfactory, so dependable, that they either have entirely discarded their own generating plants, or have retained them only as spare or partial sources of power supply. There are many concerns in the United States that have central-station loads of 30,000, 40,000, even 50,000 kw.

Since the award of the Lamme Medal to Forrest Ricketts was largely caused by his achievements in the field of power control, some of his outstanding inventions may be of interest. While his endeavors were by no means confined to this field, undoubtedly he is best known for his contributions toward the safe and sure control of power generation and distribution.

At the time he became associated with the Consolidated Gas Electric Light and Power Company of Baltimore, he found the protection of these systems from short circuits not keeping pace with the system growth. About the only protective relays available were of the straight, overcurrent type. While these could be given a suitable time delay for normal overcurrents, they operated almost instantly when subjected to severe short-circuit currents, because the operating force in a device of this kind is proportional to the square of the current. This was an excellent characteristic for small central stations having only a generator bus and several outgoing radial feeders; but when increased usage of central-station power brought about more complicated distribution systems, with main lines going out from the main stations to re-

mote distributing points whence branched out other circuits, this fast operation of overcurrent relays caused all the circuit breakers all the way back to the power house to be opened simultaneously for short circuits far out on a remote feeder. There was no selectivity; and there could be none, if all the relays operated instantly.

Mr. Ricketts solved this problem with his torque compensator, which was a kind of transformer placed in the current circuit to the relay and so designed that, when very high currents flowed in the circuit being protected, magnetic saturation would limit the amount of current to the relay.

An incident which is characteristic occurred during Ricketts' early developmental work on inverse time limit of relay action. He was comparing with a prominent consulting engineer their respective inverse time limit curves of relay performance, which on casual inspection looked alike. After an hour's discussion the consulting engineer made closer inspection of Ricketts' curve and exclaimed, "Oh, your curves are plotted current versus *cycles!*" His own curves were plotted current versus *seconds*. In other words, Ricketts was 60 to 1 ahead of the art!

Forrest Eugene Ricketts

In this manner overcurrent relays were given a definite time characteristic for heavy overloads, which meant that, working back from a remote feeder to the source, the successive relays could be given progressively longer time-settings, and thus allow time for the relay nearest the short circuit to open its circuit breaker before relays nearer the source would operate. This was the beginning of selective relay action, and the torque compensator is still in use today, with no basic change in principle after 30 years.

RELAYING OF PARALLEL CIRCUITS

Further loading of distribution systems brought about parallel lines between sources and distributing points, and for these a new problem arose. When a short circuit occurred near the load end of one of a set of parallel lines, the short-circuit current divided almost equally between the two lines. The two sets of relays at the source end—as well as the two sets at the load end—having the same current in them, could not distinguish which line was in trouble and so had to interrupt both, defeating the very purpose of the duplicate lines. Mr. Ricketts' solution of this dilemma was to devise relays that not only distinguished between the clear and the faulted line, but took out the time delay as well. In this connection he seems not only to have pioneered balanced current relays, but to have made most of the subsequent major improvements as well.

First, capitalizing on the fact that the currents in a set of parallel lines were equal if the short circuit was beyond the next station, but were unbalanced in either magnitude or phase or both if the short circuit was on one of the lines, he devised means for short-circuiting the torque regulator on the relay associated with the faulted line, thus allowing it to operate instantly and trip the proper circuit breaker.

Enlarging on this, he added ground current relays at both ends of parallel lines and reverse current relays at the distributing end, thus increasing the sensitivity as well as the selectivity of line relays. These devices, too, are still in wide use today in substantially their original design.

RAPID-RECLOSING CIRCUIT BREAKERS

Not satisfied with being able to disconnect short-circuited and grounded lines quickly and selectively, Mr. Ricketts also concerned himself with means for getting them right back in service as soon as the arc was interrupted. He had found that at least half the short circuits that occurred were of a temporary nature, such as power arcs following lightning discharges, and that in such cases an immediate reclosure of the line circuit breaker was successful in restoring service.

He therefore invented relays that not only would start immediately to reclose the line, several times, but also would limit the reclosures to a predetermined number. Thus service to a faulted feeder was usually restored immediately, instead of after the relatively long delay attendant upon manual reclosure, and in general, power customers were not even aware that an interruption had taken place. This idea not only has been applied to the majority of radial distribution feeders, but is rapidly being extended today to high-voltage tie lines as well.

In addition to his developments in the art of selective

relaying and circuit reclosing, Mr. Ricketts also turned his inventive genius to regulators, another factor of prime importance in the successful operation of a power system. He invented regulators sensitive to both voltage and current, whereby he could hold constant voltage either at the generating station or at some remote point in the feeder system.

It can be safely said that Forrest Ricketts himself is largely responsible for the present-day ability to protect and regulate large power systems so surely, so safely, so efficaciously, that the record of discontinuity of service is almost nil.

LAMME-MEDAL QUALIFICATIONS

The bequest in the will of Benjamin Garver Lamme provides for annual award to an Institute member of a gold medal to encourage interest in and give recognition to "meritorious achievements in the development of electrical apparatus or machinery."

One will go far to find a man contributing more than has the 1941 Medalist to the development of means to make possible the growth of power systems to present-day proportions. Mr. Ricketts' contributions to the art, through his many inventions, have had, and will continue to have, great value. He truly deserves the distinction and honor attached to the medal.

In a poem depicting "The Spirit of the American," Rudyard Kipling says:

> "Enslaved, illogical, elate,
> He greets the embarrassed gods;
> Nor fears to shake the iron hand of Fate,
> Or match with Destiny for beers."

The very antithesis of all these six specifications is the character of the American who is the Lamme Medalist of 1941.

As to "enslavement," Forrest Ricketts merits rather paraphrase of a passage of Holy Writ in the Gospel of St. John, "Thou shalt know the truth, and the truth shall make thee free."

Without inexorable "logic" in thinking, his continuing success throughout the years could not have been won; and stimulation to further achievement, rather than "elation" over ground gained, has been his guide.

The modesty of his approach to problems of man, method, or matériel has "embarrassed" no gods in his greeting; he shakes no "hand of Fate," in a spirit of predestination, but seeks solution of his problems with unwavering perseverance; nor does he gamble with "destiny" at all, but wins his way by following hard on the orderly arrangement of sure knowledge with unswerving assiduity.

In large measure, his success has come from practice of his own philosophy, which he epitomizes with "E's;" not the ease of "*dolce far niente*," but, in his own words, the "E's" of "Effort with Education and Experience."

In this award to Mr. Ricketts, in very truth, Honor follows Merit.

AIEE Lamme Medalists

1928	Allan B. Field
1929	Rudolph E. Hellmund
1930	William J. Foster
1931	Guiseppi Faccioli
1932	Edward Weston
1933	Lewis B. Stillwell
1934	Henry E. Warren
1935	Vannevar Bush
1936	Frank Conrad
1937	Robert E. Doherty
1938	Marion A. Savage
1939	Norman W. Storer
1940	Comfort A. Adams
1941	Forrest E. Ricketts

Luck and Accomplishment

FORREST E. RICKETTS, 1941 Lamme Medalist

I wish to express my appreciation of the honor that has been conferred on me by the Institute in awarding me the Lamme Medal for 1941. Naturally, I had been somewhat aware of my contributions to the industry, but I had not realized that they might be of special interest to the Institute. In the past, the awarding of the medal has always suggested achievement and progress to me. Now, I have a more complex reaction to the event, and I am not able to resolve my feelings clearly. At any rate, the award is particularly gratifying to me, because it has encouraged me to entertain the idea that I also may have contributed to the progress of the electrical industry. Realizing, as no one else can, how the turning points of my life depended upon chance events, I feel as thought I were being honored for being lucky.

I was born on a farm in Maryland, at a time when the electrical industry was beginning what was destined to be a most spectacular development. That was certainly luck for me. Of course, many others came into the world at about the same time, and even in Maryland, so those events do not, by themselves, fully account for my career.

While attending high school, I had already become somewhat interested in the electrical industry. However, after graduation, I lingered for several years on the farm. While I was not exactly dissatisfied there, I was evidently not altogether satisfied, as I decided to seek employment elsewhere.

Consequently I wandered to Newport News, Va.; Los Angeles, Calif.; Chloride, Ariz.; back to California; and then to Washington, D. C., living on the electrical industry in each instance. Although at the time I did not realize it, I was lucky in having these experiences, as they constituted a liberal education.

While in Washington, I was

assigned for a time to operate a rotary station where there was located a storage battery equipped with an end-cell switch for changing the voltage. The switch was controlled from the switchboard, and as it was free to stop at any position in its travel, it often came to rest short-circuiting a cell, in which case the switch usually would burn up. During spare time I rigged up an automatic control that allowed the switch to stop only in the correct position.

When this job was completed, and the device was working satisfactorily, I made myself comfortable at the desk. Unfortunately, I had failed to provide an automatic bell for the door, so that shortly thereafter, when the boss came in, he found me asleep. He was one of my fine bosses. However, on this occasion, he showed more interest in the ethics of operation than in automatic control. So far as I can now recall, I never did get the opportunity to explain my automatic control to him. Even so, I was lucky in not being fired, and in that he still entertained confidence in me.

In fact, I have always been lucky in having bosses who were rather extraordinary men, and somewhat liberal toward my inclinations to try new things. From my own experience, I would say that bosses generally are just about what you make them.

I do not mention this instance in my Washington experience on account of any direct connection it might have with the Lamme Award—the committee certainly did not know about it—but rather because I want to confess to a personal characteristic that seems to have been to some extent responsible for whatever new developments I may now be credited with.

This end-cell switch, and others like it, had repeatedly given trouble, of which many operators were aware without becoming interested. However, this same situation seemed to direct my interest to the mechanism of the switch until I could no longer tolerate its deficiency, and promptly set about to improve it. Since then I have literally enjoyed the many extra hours of work which it has been my privilege to spend on such problems.

After working in Washington for a while, I obtained employment with the Consolidated Gas Electric Light and Power Company in Baltimore, Md., by which company I am still employed. On arriving in Baltimore at my new job, I found what might be called an electrical menagerie: generating stations located here and there; direct current, 25, 60, and 133 cycles; single, two- and three-phase; several varieties of series-arc machines and machines not sychronized. There were even induction-type alternators. Can you imagine a better opportunity? All this lay before me, and at a time when the evolution that has brought the electrical industry to a position second to none, any way you take it, was just getting under way.

At about this time in Baltimore, the 120/240-volt d-c three-wire system was replacing the 250/500-volt three-wire system. This change left on our hands a number of rotary converters which, when operated at 250 volts, would carry only one half of their kilowatt load. It occurred to me that if we could connect the rotary winding in two parallel circuits, these machines would then carry full kilowatt load at half voltage. I mentioned this idea to my boss, and he suggested that I visit the factory and discuss the matter with the designer of the machines. That I did promptly, but was assured that my idea would not work. However, when I returned to Baltimore and reported the adverse opinions of the designer, I also stated that I was still confident that the rotaries could be made to operate satisfactorily at the lower voltage.

Permission was given to try the idea on one machine. The alteration was completed in less than a day, and the machine performed as anticipated. The trick was to advance the top wire in each commutating segment one step ahead, which gave two armature windings working in parallel instead of one in series, and to connect the field coils into two parallel circuits at half voltage. The transformer coils were also connected in parallel. However, there remained the problem of commutating currents of twice as many amperes as was necessary before the change. This problem was readily solved by using brushes of twice the thickness of those formerly used. This was feasible because the commutating point was now twice as wide as it had been before the change. Five rotaries were altered in this manner and they are all giving satisfactory service after more than 30 years. I have mentioned this problem because it again illustrates how relatively simple solutions to problems may often be found if we become deeply interested in the things we work with, and like the end-cell switch problem, its solution also serves to illustrate the characteristics that have been largely responsible for my receipt of the Lamme Medal.

When an honor of this kind is conferred on an individual, the effect is often to inspire others to high achievements in their own specialties. In fact, I believe that is one of the purposes of such awards. In line with that purpose, I venture to suggest certain generalizations concerning the development of new ideas, which have been corroborated by my own experience. First, you must understand your problem; then if you are genuinely interested in it, you are well on your way to a solution. But to reach the goal you must be persistent. Your understanding must be clear and visual, and your interest must be not only continual, but consuming.

In my case, I have had the good fortune to work under favorable circumstances, and to have had an abundance of problems relating to my responsibilities. What I have accomplished may be considered a natural result.

In conclusion, I confess that throughout my career I have been motivated solely by an interest in working on problems rather than by any thought of reward. I hope others will have the good fortune to find problems that will command their interest also, since there is still much to be done.

Democracy in Its Struggle Looks to the Engineer

D. D. EWING
FELLOW AIEE

A MAN once wrote a letter to the head of his government, offering his assistance in time of war. This man possessed a highly trained mind, a very creative imagination, and exceedingly skillful hands. He wrote, among other things:

"I have a method of constructing very light and portable bridges, to be used in the pursuit of or the retreat from the enemy.

"I have also most convenient and portable bombs, proper for throwing showers of small missiles and with the smoke thereof causing great terror to the enemy.

"I can also construct covered vehicles, secure and indestructible, which entering among the enemy will break the strongest bodies of men.

"I can make powders and vapors for the offense of the enemy.

"I have methods of making vessels . . . that shall resist the most powerful bombs."

A rather up-to-date list! Yet the letter was written nine years before Columbus discovered America and the writer was practically a contemporary of the fabled Arnold von Winkelried who with his own body breached a phalanx in the army of another Austrian dictator in order that the freedom-loving Swiss might live as men and not as slaves.

Toward the end of his recital of his capacities as a designer and constructor of military equipment, the applicant observed, as a sort of an aside: "In painting also I can do what may be done, as well as any other, be he who he may."

It would seem from the record that this skilled man's ducal overlord chose to make a greater use of his architectural and artistic skill than of his ability as a military engineer, and it could be reasoned that, as net consequence, today's balance sheet in the world's mythical hall of fame carries the name of Leonardo da Vinci as one of the greatest of the "Old Masters," while the house of Sforza is unknown and Milan is only an Italian city.

In da Vinci's time and for long thereafter, battles were won in the von Winkelried manner—by the impact of fighting man on fighting man—for despite the skill of men like da Vinci, military leaders were loath to abandon the old orthodox personal-combat style of fighting.

In the last analysis wars are still won by man power. To win, armies must still occupy cities and lands previously occupied by their enemies. The air over these cities and lands must be dominated by the air fleets of the victors. The ports and harbors, even the oceans, must be ruled by the naval forces of the winner. Our own war cannot be won otherwise than by the impact of our armed forces upon those of the enemy and by the displacement of the enemy from the land, sea, and air areas he now occupies. Let it be understood, here and now, therefore, that we have no thought of minimizing in any way the absolute ultimate necessity, in this war of ours, of the trained fighting man with a real fighting spirit; of vastness in the armies and in the navies of the sea and the air; and of the enormous sacrifices of freedom, blood, and treasure necessary for final victory.

There is an old saying that "Man cannot live by bread alone." There is a lot of truth in this saying, and it is just as true that today wars cannot be won by fighting men alone, no matter how good their fighting spirit, their discipline, their leadership, their individual resourcefulness and endurance, and their willingness to make the ultimate sacrifice for their cause. Bare hands just cannot be matched against tanks and airplanes, machine guns, and fire throwers.

The record of this war shows, if it shows anything at all to a layman, that to win, every type of implement of offense and defense must be instantly and always at hand and at hand in adequate quantity. "Too little and too late" has been the inseparable companion of calamity. To carry the fight to the enemy or to defend itself, an army must have "striking power." "Striking power" seems to be a matter of momentum—of mass and speed—and the destructiveness of the stroke a matter of mass and of the square of speed. The armies and navies of fighting men can furnish the mass factor in these dualities but in only a limited way can they furnish the speed element. To improve mobility and striking power Rameses and later overlords of the Near East used chariots. Hannibal and others used elephants, and the horse has been used since primitive times. These accessories to the fighting man's complement are well known. So are their limitations, and there is no point in mentioning them here, save that their use through the years has been an indication of the urgency of the need for increasing the speed factor in warfare.

When da Vinci "dipped into the future far as human eye could see" in the field of the military arts, he apparently saw vastly more and much further than his contemporaries. He saw the need of striking power and speed in forms more potent than animal power could give. He even had ideas about flying machines. And he

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D. D. Ewing is head of the school of electrical engineering, Purdue University, Lafayette, Ind.

must certainly have concluded that the von Winkelried fashion of warfare could be greatly improved upon.

And why now, half a millennium later, does "Democracy in its struggle look to the engineer?" Why does the United States, our great nation of free, self-governing men, fighting to save its fair lands from the depredations of marauding dictators, fighting for its ideals of freedom, of equality of opportunity, and of free enterprise, look to those who are trained in "the art of organizing and directing men" and who, by using the facts and laws of science, can control the physical "forces and materials of nature" in an economic manner "for the benefit of the human race?" Why does the British commonwealth with its heritage of half a thousand years of practice in the art of self-government and in the art of defending its ideals and its lands look to the disciples of Watt and Rankine, and the famous Thomsons, rather than to the disciples of Marlborough and the Iron Duke, or to the shade of Coeur de Lion? Why do other peoples less fortunate in their national heritages, but nevertheless as freedom-loving and as individualistic, look to the engineer, the man trained in the creative sciences and arts? Why? In the first place, because for three quarters of a century the genius and skill of engineers and other scientific workers have brought to them the useful things and the luxuries of life—opportunities for employment, high wages, transportation, communication, comfortable homes, and good food, to name a few—which have made America a Mecca for the rest of the world. The peoples of the democracies look to the engineer because they have come to have confidence in him as a worker of modern miracles.

The engineering genius that has given the United States the world's highest living standards in peacetime can put into war materials the speed factor needed to overcome the inefficiency that is part of the price of democracy, according to this engineering educator, who believes our production experts will convert "too little and too late" into "enough and on time."

Secondly, because machines play such a great part in modern warfare, and machines are the brain children of engineers. Thousands of engineers are required in the uniformed services simply to operate and maintain the modern "engines of war"—battleships, airplanes, tanks, docks, airdromes, trucks, guns, detector systems, communication systems, roads, bridges, and army camps. The modern soldier often must be a mechanical technician as well as a fighting man, and the training of technicians is in part an engineering job.

Thirdly, because the present war presents three great civilian problems connected with the defense industries: organization and direction of civilians in the defense industries, the need for superiority in production machinery, the necessity for superior quality in war matériel.

It has been said over and over again that this is a war of materials and equipment. But it is much more than that. When, if ever, in the history of the world were such great numbers of men under arms? Whenever were there such vast navies of the sea and of the air? Whenever were so many men needed in the manufacturing and transporting of the materials of war to the armed hosts? Whenever were so many men needed for work in Earth's storehouse of raw materials? In what other war were so many men needed to service and maintain the implements of the warriors? The wild-riding hard-fighting hordes of Genghis Khan and the armies of whip-driven slaves of the pyramid-building Pharaohs were not, in numbers, comparable to the armies of today, and their services of supply and maintenance were practically nonexistent.

Of the three problems, one involves the organization and direction of the great army of civilian workers who man the cargo fleets of sea and air, the factories, and the sources of raw-material supply. Of course, others beside engineers organize and direct men. In the armed forces that is one of the prime functions of the admirals and the generals. But where the work involves construction, production, transportation, and communication, it is peculiarly in the field of the engineer. It is true that this work has to be done under pressure and that it is of an emergency character. But engineers have long been accustomed to working under pressure and dealing with emergencies. The forces and materials of nature, with which the engineer works, often seem, at least, to be engaged in wars of their own.

But in order to construct, produce, transport, and communicate, the worker must have the necessary equipment. This constitutes the second problem. We have all heard many times over that the United States has more railroads, communication lines, automobiles, hard roads, radios, refrigerators, bath tubs, and so on, than any other country in the world. It takes production machinery and skill to produce these things. Our production men long ago taught themselves the art of mass production and then out of the goodness of their hearts generously gave of their knowledge and craft to other peoples of the world for their betterment. Some of these other peoples now are our enemies, but we believe that our people who were the originators and instructors are still a long step ahead of their ungrateful pupils.

The story of production, from iron mine to army tanks, for example, is a long one—explosives, power shovels, mine cars, docks, ore-loading equipment, lake steamers, canals, locks, railroads, ore-handling equipment, blast furnaces, red-hot ingots, rolling mills, forge shops, machine shops, jigs, fixtures, automatic tools, giant presses, all feeding into great mechanized assembly lines for tanks—a saga of mechanisms, and a tribute to the

workers, technicians, and engineers and to technology.

The two problems which we are now discussing might well be merged into one problem—the pressing problem of "too little and too late." This problem is a fighting challenge to the production expert. It irritates him as a red rag is supposed to irritate a bull. His watchword always is "enough and on time." Give our production engineers a chance, cut the red tape, pork-barrel strings, and the other fetters that hamper production, and "too little and too late" will become a forgotten phrase. Here in free America the peacetime ramifications of this problem have been solved in a way not even approached in other countries. Fortunately, no new principles or inventions have had to be developed to meet the wartime aspects of the problem, but unfortunately many new machines for tooling our war industry plants have had to be built from the ground up.

The third great problem is that of putting the "invisible ingredient"—the speed factor—into our wartime maétriel; putting that quality into our guns, our ammunition, our ships of war, our airplanes, our tanks, and all the other equipment, so that in time of battle and in the preparation for battle, our armed forces may have the necessary striking power, the military momentum—the mass factor of their numbers combined with the speed factor of their equipment—that will enable them to strike decisively and with destructive energy in every blow.

For surely it is as true in war as it is in peace that "To him that hath shall be given, to him that hath not there shall be taken away even that which he hath."

Democracies, say the dictators, are slow and fumbling, are lacking in the ability to make decisions, are spineless, more interested in money than in national honor; are unwilling and unable to fight. In some of these charges there may be some measure of truth. In times of peace in the United States, the duly elected chief magistrate cannot arise some morning after an attack of insomnia and order our armed forces to invade the lands of a neighbor. Free men feel that war is some thing in which they are or will be vitally concerned and so do not permit the making of major decisions in such an irresponsible manner.

The extra costs to us as a nation and as individuals of having to make up quickly for our neglect of defense are part of the price we must pay in order that in normal times we may order our lives as we will.

There is also a tendency in times of peace to forget that every country in every age has needed armed forces for protection against external aggression. We have always recognized that such forces in small number are necessary for internal policing, but we have depended on natural barriers and our fleet for protection against aggression, perhaps unduly. Britain has done the same thing and done it quite successfully for the past 800 years. New inventions and new developments in the arts of war have changed things, however. The old defenses are no longer real protective barriers. Until suitable replacements for these barriers can be found, war is likely to find the free peoples more or less unprepared to defend their freedom. Despite our experiences of the last war the United States was almost wholly unprepared for war two years ago. We had been having our depression troubles and had given little real attention to the rumblings in Europe, which seems to be in these later centuries the playground of Mars.

We are having to make up quickly for the negligence of bygone years. Hurry-up work is usually not done economically and efficiently. The extra costs and labor to us as a nation and as individuals are part of the cost of freedom, part of the price we must pay in order that in normal times we may order our lives as we will, without let or hindrance from a prying, arrogant, and dictatorial governmental Gestapo.

How can this inefficiency in the maintenance of the national-defense mechanisms be met? Materials, equipments, the direction of men, and the application of the laws of science in production are engineering problems. Our inefficiency in defense maintenance can be and is now being remedied by the application of scientific methods to the production of war necessities.

Are we willing to spend money to defend our honor, our homes, our lands, and our ideals? The records show that we are. We were not stingy in money matters during the last war. We were probably too generous in every way then, with our vanquished foes. We are not being stingy in this war. What nation ever spent at the rate of $50 billion a year, measured either in dollars or in the amount of the world's consumable goods that the dollars will buy? Can freemen fight? History says yes. The free warrior, man for man, has always been the superior of whip-driven serf or the fighter for wage. A thousand battlefields from Marathon to Bataan attest this. Only when free men become so familiar with freedom that they forget it is a priceless heritage, to be maintained only by strenuous effort, and turn their affairs over to bureaucracies or to self-anointed and self-appointed leaders, do they become supine, spineless, and unwilling to fight. Have we in the United States come to this stage? Von Ludendorf did not think so 20 years ago when he wrote in a spirit of bitter admiration that the United States understands how to make war. He knew from bitter experience that our fighting forces knew how to combine mass and speed to secure irresistible momentum and destructive striking power.

What assurances do the American people have that by the application of basic engineering principles in war-material and equipment production we can overcome the inefficiency and losses caused by our lack of preparation and the slowness of governmental decision?

There was a great deal of comment in the months be-

fore and immediately after Pearl Harbor criticizing rather caustically the apparent slowness of American industry in shifting from the production of peacetime goods to wartime necessities. This criticism came from many groups of our citizens; even some engineers waxed emphatic on the theme. To most people not connected intimately with production, a shop is a shop, tools are tools, and workmen are workmen. They see no reason why a shop that is equipped to build, let us say sewing machines, today, cannot start tomorrow morning in full production on machine guns. Few realize that such a procedure would entail the complete retooling overnight of a shop, the tooling of which for the peacetime product may have been a developmental process extending over a long period of time. As an example, for a certain well-known type of gun, retooling might involve a matter of 10,000 gauges, 6,000 jigs and fixtures, and other tool items in proportion. Certainly this is not a holiday week job. Further, such a change involves new and different inventories of stocks and a complete retraining of the production workers from messenger boy to works manager.

Our negligence and inefficiency in the maintenance of national-defense mechanisms is now being remedied by the application of scientific methods to the production of war necessities.

Production men will recall that it took nearly two years for one of the large automotive manufacturers to change models completely when the change had to be made without the usual two or three years of advance preparation. To me the changeover here in America has been little short of miraculous. I take off my hat to the men who have done the job. Everywhere, we now hear of new plants, old plants, rebuilt plants, one and all setting new production records in war materials and equipment. What can be said now is that no nation ever worked such wonders so quickly. Furthermore the products have built in that extra quality so necessary for the Army and Navy in field of war. Here in America the assurances of our success in this matter are all around us. Our homes, our food, our clothing; our electric lights, refrigerators, sewing machines, washing machines, and vacuum cleaners; our motor cars, radios, telephones, telegraphs, railroads, trucks, tractors, farm machinery; our factories, and so on, ad infinitum, attest to the ability of the nation to produce needful and desirable things. Willow Run, the Chrysler tank arsenal, and unnumbered and unnamed other great plants exemplify the speed with which open country can be changed into high-capacity war-material production plants.

Our greatest assurance is that during the last three quarters of a century we in the United States with shorter working hours, have achieved a higher standard of living, and a greater abundance of the things that make life worth living, than has any other country in the world. The totalitarian powers with their longer hours, their stricter discipline and restriction of the individual, have achieved no such results. Even the results they have achieved in peace and in war have been largely the work of the copyist and not of the originator. Count the great inventions of the last 150 years and note their countries of origin. The cotton gin, steamboat, telegraph, telephone, electric light, phonograph, typewriter, cash register, sleeping car, safety razor, linotype, radio, reaper, automobile, vulcanized rubber, cellophane, power farm machinery, aluminum-reduction methods—all are evidence of American genius. Someone has computed that no less than 75 per cent of the great modern inventions are of American origin. No mere chance occurrence this, but the result of free men working with untrammeled minds in and for free enterprise. Driven men look downward and sidewise and not upward and outward. Dictators are surrounded by "yes" men and not by men with clear vision and creative imaginations. The Whitneys, Fultons, Whites, McCormicks, Morses, Bells, Goodyears, Pullmans, Achesons, Edisons, Baekelands—only to mention a few—and others of the inventors clan do not thrive under a despot, however benign. Masters of ideas, of things, and of the forces of nature, they need the clear, exhilarating air of freedom in order that they may thrive to advantage. Our own great engineer, Steinmetz, seems to me to be an excellent illustration of this idea.

Our enemies seek a "place in the sun," "a more abundant life," by the methods of Cain and Esau, by taking the wealth of the frugal, the industrious, and the creative folk of their own lands for their camp and court followers, and when this source is exhausted they seek to prey on the wealth of other lands.

We in America have not acquired our wealth of goods and our high standard of living in this way. As a people we have worked, and worked long hours, to convert a wilderness inhabited by a few roving tribes of savages into a great and wealthy commonwealth. Our system of education, our patent system, the fight to maintain ourselves in a new land, freedom from restrictions, and good government have worked, in the last 150-odd years since Washington was inaugurated as President, to develop the creative genius, the high idealism, high level of living conditions, the spirit of fair play, and the straightforward ways of thinking and acting that have made the United States both admired and envied by the rest of the world. Can we give to our army and navy the speed component of their striking power by giving them in time and in plenty superior weapons and equipment? Engineers who plan and design, and their coworkers on the assembly line, in the tool room, on the test floor, and in the fabricating shops know that we can and that we will. The democracies of earth shall not look to the engineer in vain.

A Backward Look for a Forward Plan

FRANK C. HOCKEMA

The present demand for trained individuals with good health and surplus energy has placed a new and greater emphasis on all phases of education. In this changed world, we are recognizing the need for reformulating the objectives of our educational system, for considering such departures as, for example, the provision of programs based on the aptitudes of the individual student and terminating when the limits of those aptitudes are reached instead of at four-year intervals. The opinions of some nationally known educators and employers of college graduates are cited in this article, which may be regarded as a straw in the wind.

THE TRAGIC DISORDER of the world of today will have an inescapable influence upon the whole future of our American social, economic, and educational systems. Bacon, in *Novum Organum*, said, "If a man will begin with certainties he will end in doubts, but if he will be content to begin with doubts he will end with certainties." A backward look, with doubts, over the changes that have taken place in higher education during the past few years, especially the last two years, and the proper appraisal of them will give us an outlook with some degree of certainty on the changes which we may expect in the near future and enable us to make plans accordingly. The national defense program has imposed immediate changes upon institutions of higher education—changes which in all probability will have an enduring effect. Other lasting changes are certain to result from the economic and social problems which we already have encountered and those which we are bound to face after this world catastrophe.

The war has compelled us to put everything under the microscope. We hear that we need more and more trained men and women; that we are complacent; that we are soft; and that we must revamp our educational system. Abounding plenty during the past several years has not mothered many notable virtues in us. Threatened scarcity and rationing of the things to which we have become accustomed may bring us back to earth. During the past few months, education has become a stern and serious process. The critical situation of the world today—complacent confusion, frenzied fear, grotesque greed, heated hatred, silly superstitions, and sordid selfishness—demands men and women whose horizons extend far into the future, like the early settlers of the United States. It calls for men and women who can see beyond the things of a temporary and passing nature—beyond the confusion and the fear and the hatred and the bitterness and the greed and the selfishness generated by war—who are willing and ready to combine their powers and efforts to chart the road to progressive civilization. That road must necessarily be paved with tolerance, understanding, justice, and fairness, with due consideration given to minority groups. The debris resulting from civilization in reverse must be cleared away and civilization rebuilt on a sound basis. The brunt of this assignment will be allocated to the American school system, both public and private institutions. Much attention will have to be given to the elementary and secondary schools where the foundations are laid for the most significant part of American citizenship.

Doctor A. G. Grace, in his bulletins "Learning to Make a Living" and "Living and Making a Living," lists the following general objectives of public education: self-motivation, vocational preparation, moral integrity, civic responsibility, intellectual competency, cultural appreciation, and physical well-being. In an age of mass production of machines, there is a tendency among educators to apply similar methods of mass production to the American school system. This, of course, is a natural tendency, and to some extent it is inevitable. While standardization is a step forward in the industrial field, it does not necessarily mean progress in the field of education. It is not always sound procedure to apply to human beings

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Frank C. Hockema is assistant to the president, Purdue University, Lafayette, Ind.

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methods which worked in the material realm. Each personality is distinctive and must be dealt with as such. Each community should develop the particular kind of education which best suits the needs of its people and the opportunities it offers.

In the past the shortage of opportunities to learn trades made boys and girls the victims of an educational system that had no connection with the art of earning a living, and that headed them toward the human scrap heap. Since the beginning of World War II the educational institutions, trade schools, apprentice schools, and industries have joined hands and are endeavoring to develop the powers of large numbers of men and women by putting a book in one hand of each and a tool in the other. The sole object of this joint program is to teach self-reliant citizens to work in various fields necessary to the national defense program. This training is not only preparation for practical living but is also a stimulus to independence of character. Because of individual differences it should not matter whether the service be painting masterpieces or lumberjacking, writing novels or driving a grocery truck, leading an orchestra or cultivating a tract of land, commanding the applause of audiences or teaching in a remote district—*if the particular job exercises all of the individual's best powers, that person will be doing all that anyone can hope to see him do.*

The national-defense and war programs have provided thousands of new jobs. The scarcity of qualified workers to fill these new jobs is testing our educational system and finding it wanting in many respects. Formerly we spoke of standardized four-year prescribed courses, and now we offer special short courses to thousands to train them on a job or for a better one. The longer the present plan is in effect, the greater its influence will be on our future educational program. Many employers maintain that entirely too much time has been wasted in teaching nonessentials and not enough devoted to fundamental courses and to teaching students how to think.

In order to train the youth of tomorrow most effectively for its work in a changed world, a careful study must be made of the factors involved in such training. To this end a careful and sympathetic, yet practical, approach to the subject has been made through leading educators, to whom we must look for the supply of material, and through business and industrial organizations, to which we must look for the use of this material. The ideas of nationally known educators, educational officials, college and university presidents, members of research institutions, and business and industrial executives are incorporated in this article. These will serve us in the training of youth for tomorrow.

To attain the fullest measure of satisfaction from living and working, every American citizen of tomorrow should have an opportunity to receive just as much education as will be of real benefit to him. This certainly does not mean that all should have an equal amount of schooling. Some individuals who have been admitted to high school reach the limit of their mental capacity before the end of the first year; their intellects will not continue to develop if they remain in school longer. Others are so constituted that they will continue to grow mentally through several years of advanced study; for them our graduate schools are organized. However, the vast majority of our population—many of whom have neither the mental capacity nor the academic preparatory training for college work—has come to regard college and advanced degrees as necessary stamps for social approval and business, industrial, or professional success. This is most unfortunate. During each of the four years of high school and the four years of college, a certain number of students reach their limit of academic progress, because of limited intelligence or because they are in fields of training which are not in line with their interests and aptitudes. There are others who, having finished the basic work given in the secondary or preparatory school, can profit greatly from certain types of vocational and academic courses given in college but who will not benefit from subjecting themselves to all the courses required for a degree. These men and women might well be given an opportunity to take certain work in college, outlined in a definite curriculum but not leading to a degree. No doubt most of them should be advised to supplement their college course with work in an apprenticeship, a trade, or a vocational school. Tact, as well as ability to estimate individual differences, will be needed to overcome the objections of the students and the parents who believe that a different type of education means an inferior type and consequent social inferiority. Perhaps the college should place on such students a stamp of approval in the form of a certificate of achievement after the completion of courses shorter in years and different in kind from those required for the diploma.

As one outstanding educator puts it, "The great weakness in youth education today lies in the fact that it is still entirely too academic. A million and a quarter young people will be graduating from high school this year. Two thirds of them will be prepared for college. A third of them will go to college and many of those will not stay in college very long. That is not a system of education in keeping with the mechanical age."

It is timely to provide American youth with adequate educational facilities and competent teachers. We have an annual crime bill estimated at 15 billions of dollars; a large portion of this enormous sum could be saved in educating the potential criminals to become legitimate wage earners. An improved educational system that would teach young men and women to cope with poverty, monotony, and the feeling of being "not good enough"—the chief causes of desperate deeds done in defiance of the social order—would do much to reduce the overwhelming crime bill. A reasonable portion of the saving might well be used to pay higher salaries to competent teachers and to provide for the necessary additional educational facilities and the necessary additional

teachers. Upon the elementary school teachers must be placed the enormous first responsibility of teaching and developing devotion and loyalty to the democratic form of government.

The present defense situation has called our attention also to the physical welfare of children and youth. Health and physical fitness are so vital to social progress, as well as to the individual's happiness and success, that every movement toward their conservation should appeal to the good citizen.

Another effect of the present war is the increased attention which is being given to vocational training and preparation by the entire school system. This attention will undoubtedly increase in the future and will give more prestige to manual work. During the past decade there has grown up a curious antipathy to manual work. Now everything depends upon whether the individual worker understands his work and what it means, what part it plays in the human economy and national defense, and whether he is ready and willing to do his level best to make it productive. The United States has lately come to realize that the mechanic is one of the most important men in our first line of defense. We are now paying tribute to men who know how to work with their hands as well as with their heads. Men who have never worked with their hands have missed something of great importance. There is a quality of sturdy, confident, intellectual approach discernible in those who have been trained to work with their hands and have acquired manual dexterity. Because of the war, people who work in factories, especially the skilled workers, are being paid very high wages. In the future there will be less distinction between the white- and the blue-collar workers. This will have its effect on college and university postwar programs.

The increased attention given to vocational training by elementary and secondary schools will probably divert a much larger number of pupils into workshops, trade schools, and apprenticeships, while the academic group will pursue a college course ranging from one to seven years in duration on the basis that needs of the student shall determine his curriculum.

Men and women with different backgrounds, who need and want an education in order to become the highest type of citizens of which they are capable, represent a great diversity of ambitions, attitudes, and abilities; many degrees of preparation; and a great spread of intellectual, social, vocational, and professional ideals. Since it is a democracy's duty to educate the educable, provided they want to become educated, the question arises, who should attend institutions of higher learning, and for what and to what extent should they be trained?

Another question is, what is to become of the institutions of higher learning? The world crisis, bringing with it an unpredictable economic condition world-wide in scope, has already affected the institutions of higher learning—the endowed institutions because of diminishing gifts, contraction of the securities markets, and the decline of interest rates; and the state-supported institutions because of a diversion of taxes to defense. This will probably mean a curtailment of the institutional activities, and for a large number of the smaller institutions economic collapse, either now or in the near future.

AIMS AND PURPOSES OF HIGHER EDUCATION

Educators and employers vary widely in their definitions of the aims of higher education. The question is, how should students be trained in colleges and universities to be equipped in the best possible manner to meet the present and future needs of the professions? Most of the educators and employers are agreed that technical students should have a thorough grounding in fundamental principles, should know how and where to find the information which they do not already have, and should know how to think. Most of them agree that students should be given thorough basic work in such courses as English, mathematics, physics, and chemistry. The question immediately arises, should not the student with creative ability, who is headed for research work as a career, have an opportunity to take much more advanced work in mathematics and other scientific and technical courses than the student, for example, who is headed for a career in the field of technical selling?

The following ideas, gleaned from educators and employers, represent a summary of opinion on the aims of technical education:

1. A more thorough training in fundamental principles which, in many instances, will mean eliminating specialized, irrelevant, and flubdub courses from the curricula. These fundamentals, with simplified presentation, should be brought into the curriculum *earlier*, on the theory that the intelligence of the student does not grow during his college career, although his experience and judgment should do so.

2. A concentrated attempt to teach the student how to think, giving each one the greatest possible opportunity to develop his own capacity, which means subjecting him to every stimulus that can be provided which will awaken his interest and develop his imagination, initiative, and skill.

3. Development in each student of an appreciation of the cultural side of life, "human" engineering, and an open-minded, co-operative attitude.

4. An effort to make each student a self-sustaining unit within the social order. To instill successfully in the student an abiding sense of responsibility to the community, state, and nation, it will be necessary also to prepare him vocationally or professionally to discharge that responsibility; otherwise, the knowledge of the responsibility is futile.

COLLEGE STUDENTS

The increase in enrollments in colleges and universities during the past two decades has created many problems in the minds of educators, students, employers, legislators, and taxpayers. However, in the years just ahead the colleges and universities are likely to be faced with a marked decrease in enrollments, especially of those

students who are able to complete a prescribed four-year course and those who are qualified for graduate studies. Several institutions are already engaged in sponsoring a large number of short-term defense training courses, many of which would also be valuable for students who are not qualified to pursue the prescribed four-year, five-year, or six-year course leading to a degree. In almost all cases, students who complete the short-term defense training courses are awarded a certificate of achievement. These same institutions have failed to award certificates of achievement for work completed by students who terminated their university careers after one or more quarters or semesters of university work, a part or all of which may have been satisfactory.

Less than 40 per cent of the students admitted to technical colleges complete the prescribed courses leading to a degree. The majority of the other 60 per cent fail as a result of poor teaching, unsuitable curriculum organization, and improper methods of admission. Approximately 50 per cent of the students admitted do not finish university work leading to a degree because of so-called "scholastic failure" and approximately another 10 per cent drop out from such causes as ill health, financial difficulties, or other personal reasons.

Colleges should maintain high and exacting standards of achievement for those to whom it gives the stamp of approval for work in the fields of public service, research, manufacturing, and the like, regardless of whether the approval be indicated by a certificate of achievement or a diploma. A few institutions are able, by means of careful selection, guidance, and counseling, to graduate within the prescribed time approximately 80 per cent of the number of students admitted. Some of the endowed institutions of higher learning at the present time have enough applicants for admission to make it possible, by means of rigid entrance examinations and personal interviews, to admit only the best. On the other hand, the state-supported institutions, with but a few exceptions, admit all the students from the state who meet their rather lax entrance requirements.

College students should be carefully selected. Because applications and letters of recommendation from friends frequently oversell or undersell a student as a result of personal reactions, it would be well if each student could be given a personal interview. Scholarship, personal appearance, personality, proper mental attitude, character, initiative, health, and endurance should be given due consideration. The directors of admissions in many colleges and universities state that in spite of improved standards for admission to the university, the faculties in practically all cases continue to fail approximately the same number of students on a percentage basis, and the percentage of "A" grades, "B" grades, and so on, fall within the very narrow limits of the old traditional grade curve. This brings to our attention the fact that the age-old problem of grading students will always be before us. Volumes have been written on grading systems. Many educators feel that the grading of students by outside committees would give the instructor an incentive to try to teach his course so that the maximum number of students would be able to make a satisfactory showing, whereas in the present system where each instructor does his own grading, many instructors boast that they are good teachers because they fail so many students.

A dean of a graduate school says:

". . . We believe that the general attitude of educational people is, as a whole, entirely wrong as regards their students . . . . In so many institutions the whole attitude seems to be that of a total entering class a certain percentage, say 15 to 25 per cent, must be failed during the first year. To me this is simply ridiculous. These young people coming to us are the raw material out of which we, the teachers and administrators of educational institutions, must fashion our finished product. What would happen if the ordinary business man started in at the beginning of the year with the definite intention or policy of spoiling 15 to 25 per cent of the raw material which was to be processed in his plant? The majority of us would say that that individual was a plain fool. In our own case, we have endeavored to salvage every single student that enters this school, and I have felt that we have only done our duty if we could take men who were about to fall by the wayside, put new pep and enthusiasm into them, and carry them through their courses of study to a successful conclusion. Some such men have turned out to be among our best alumni, and, once having found themselves, are now going forward by leaps and bounds. It would have been tragedy to permit these boys to fall by the wayside."

An employer of a large number of college graduates says:

"Another failure of engineering schools, from the employer's standpoint, is that he finds difficulty in selecting a man on the basis of his standing in college. The student with apparently the very best standing may be merely a 'memory machine' and, therefore, of little value to the employer. The turnover in the employment of young engineers is altogether too great. The employer can obtain some idea of the personality of the student from an interview but he must rely wholly upon the college standing of the young graduate for an appraisal of his mental ability. Since today a student's standing, as evidenced by his 'marks,' merely indicates his application which is valuable and his memory ability in memorizing facts and formulas, it does not disclose, at least independently, his ability in perception and reasoning which is one of the chief characteristics in which the employer is interested. To apprise the student better of his educational progress and to aid the employer in his judgment in the selection of engineering graduates, an entirely different system of marking must be employed."

Many of the students complain that, instead of being allowed to obtain the maximum benefit from the course through individual thinking, they are forced to mimic the professor in order to secure a good grade. This practice on the part of certain instructors results in the evil of encouraging students to take those courses, because they know they can make good grades by merely repeating to the instructor the material he has given them. Many educators condemn our present grading system, because the keen competition tends to produce dishonesty, especially among the slower students.

The following statements from prominent educators show some methods of teaching students to think and to

learn the fundamental principles of the courses without waste of effort:

"It is my conviction that it is necessary for the student to understand what is to be accomplished and why and to be completely sympathetic with the aims and objectives if the results are to be successful. Little can be accomplished when working at cross-purposes. The time spent in orienting the student's point of view will pay large dividends. It soon develops that, in addition to personal qualifications, the things that contribute most to the success of an engineer are analytical ability and facility in the use of basic principles. These cannot be developed by memorizing textbook assignments. No text is used. They [the students] study the subject instead of what someone says about it. They are treated as young engineers rather than immature students and they respond accordingly. My function is to provide questions, problems, and general guidances, theirs to evolve the answers and solutions out of their own personal experience. Progress is built on their experience, not mine. Their first problem is to formulate, out of their knowledge of physics, five or six fundamental principles which will enable them to solve most of their problems . . . . They can supply most of the facts but need help with the wording to meet the foregoing requirement. The next step is to give them a problem with which they are unfamiliar and let them find the answer by applying the appropriate principle or principles. Of course, it is difficult for them the first month for they are on the delivery end—a new experience. Help is necessary at this stage but it is usually in the form of more questions rather than supplying the answer. Soon they find that they can solve new problems without help and are greatly stimulated by the discovery. They are thrilled by the power of personal accomplishment and this results in a further development of intellectual curiosity.

"In the early stages it is essential to provide problems of the proper difficulty, for this is a period of building up confidence. Later they can take harder blows. They like the idea of being treated as engineers."

"There is no pedagogical value in requiring the students to repeat over and over again calculations that all follow the same general pattern. Each student is, however, required to make two or three computations of each type.

"The administration of the laboratory work is entirely under the supervision of a 'foreman,' chosen in rotation from the members of the squad. There are instructors in the laboratory, but their duty is merely to be sure that no accident occurs that might injure either a person or a piece of equipment. The entire responsibility for the laboratory procedure rests with the foreman. Some time before each laboratory period the foreman consults with the instructor and arranges with him as to the procedure to be followed. The foreman then arranges the work in detail, prepares the data sheets, and instructs each man in the squad as to his individual duties. Before the laboratory period begins the foreman may consult with the instructor; when the period starts he assumes full and complete responsibility. His responsibility terminates only when the experiment is satisfactorily completed and the data book has been approved by the instructor in charge.

"Our success with the system of administration has been remarkably satisfactory. It develops in the student the ability to organize and supervise the work of others; this kind of training is regrettably lacking in most university courses. Because the men know that they are acting on their own responsibility, they do really careful and serious work; we have fewer errors than we had several years ago when the laboratory work was under the supervision of an instructor. The suggestions made by the 'foremen' in planning the work have often led to very marked improvement in the procedure."

Many of the educators feel that the student should be put on a program of study gauged to his previous training, learning rate, capacity, and interest, so that he has an opportunity to make the progress of which he is capable. In a three-credit-hour course, the slow student, for example, would receive five hours of instruction per week, whereas the fast student would receive three. Most of the low-ranking students and many of the average ones would terminate their study programs in one, two, three, or four quarters or semesters of college work. Many of these students should be transferred as soon as possible to vocational or trade schools in order that they might become better equipped to meet the needs of their prospective employers.

A few colleges and universities divide the undergraduate work into what are known as the junior college and the senior college. The junior college, which usually embraces the first two years of the undergraduate work, not only prepares for the senior college those students who are qualified to complete its work, but also provides terminal courses for those not equipped or prepared to master the study program leading to a degree. All students, when they first enroll, might well be put under the guidance of counselors who would help them determine the vocations or professions for which they are best adapted; plan a program of study to fit them for these vocations or professions; and guide them in their adjustments to educational and personal problems.

CURRICULA FOR THE TRAINING OF COLLEGE STUDENTS

Employers of engineering graduates naturally are looking for competent individuals who can fit into a particular job in the shortest possible time and with a minimum amount of training on the job. If engineering colleges are to train leading citizens who will put more into this world than they take out of it and who possess such qualities as character, enjoyment of work, initiative, mental alertness, common sense, loyalty, good judgment, ability to get along with people, good appearance and mannerisms, health and endurance, willingness to assume social and community responsibilities, curricula must be provided which will give adequate training to such individuals.

Instead of fitting the student to the curriculum, as is so often the case, the college should fit the curriculum to the student. A student, with proper advisers, can map out a program of study, activities, and experiences which best match his aptitudes and abilities. For some students this training may be broad and general, and for others it may be specifically vocational. If an engineering college has only one curriculum, only students with the proper aptitudes and abilities to master that curriculum should be admitted. There seem to be at least a few important items upon which all educators and employers agree. These are that every college man should be: (1) a master of the English language in both the written and spoken form, (2) thoroughly trained in fundamentals, (3) a thinker, (4) personable, and (5) a good citizen.

The following comment is from a prominent employer:

"Engineers have an obligation not only to apply the technical knowledge which they have been taught, but to carry the burden of inventing, developing, manufacturing, and selling the new and tremendously improved facilities for living which future generations will enjoy. Somewhere in an educational program should appear a stimulus to this faculty. A proper co-ordination of imaginative and conservative thinking should produce the things we need, in their proper order and at the proper time for our economic assimilation."

Another employer has this to say:

"Surveys show that a very large per cent of the engineering graduates do not follow the type of engineering in which they specialized at school. A very large portion of their time and effort spent in this specialized training is lost except as it teaches them to stabilize their thinking, and to apply the basic theories and fundamental principles to their problems. An attempt on the part of some schools to crowd in a great deal of material has so overcrowded their curricula that the students receive a superficial rather than a thorough training in the subjects taught. Our own experience and the experience of others in the industrial field convinces me that once the men acquire healthful work habits, a clear reasoning power, and the habit of thoroughness, knowledge along a specialized line which they may be following is readily acquired.

"The subject of human relations is becoming more and more important in the engineering field and we find the majority of the technical graduates are wholly unprepared to cope with the problem. The engineering student finds that so much time and emphasis has been placed on purely technical studies that he has no opportunity to study such subjects as human relations, supervisory methods, administrative procedures, etc. He finds himself ill-equipped to meet such problems when they arise. Actually, when engaged in his work, the engineer finds himself confronted with as many human-relations problems as do most people in other lines of endeavor. A degree of supervisory ability may be an inherent characteristic of some men, and some may acquire it 'on the job,' but certainly education of this type would prove of inestimable value to the engineer as he progresses in his chosen profession."

Several of the employers of college graduates suggest that colleges and universities give more attention to providing practical experience for students. The following plans were suggested:

1. Co-operative planning in the form of alternate months of work and classroom study.

2. Work experience as a prerequisite for admission to the university, this experience to be obtained either immediately after the completion of high-school study or after the satisfactory completion of the first two years of college work.

3. Interneship in industry. This would be supplementary to the university training in that the student would be required to spend a definite length of time—one, two, or three years—as an interne in his profession.

The majority of the educators and employers still recommend that under normal conditions a student spend nine months in training in the university each year, and three months in training in an intensive laboratory course in the university or at work in industry in his particular field. If the student is going to reap the maximum benefit from his time spent in industry, the industries necessarily will have to assume a much greater responsibility for his training on the job than they have accepted in the past. The student's knowledge of the fundamental principles will prepare him to follow any engineering endeavor he may choose. The specialized fields of study should be deferred either for graduate work or for training on the job.

Success in the business and industrial world depends not on technical training alone but on many other factors. We have come recently to regard a proper mental attitude as an important contributory factor. It is the ability of the individual to adjust himself and demonstrate the so-called "will to do" that determines to a great extent whether or not he will be a success. As an aid to the proper mental state, health and endurance should be emphasized. We need men with surplus energy. The scope of physical education in institutions of higher learning should be enlarged to include physical fitness for each student.

A few universities give extensive training in the principles of executive and administrative work. The lack of such knowledge presents one of the greatest difficulties in the advancement of a man to positions of responsibility. A course in general executive work given in the last semester of the senior year by a thoroughly competent and practical teacher would benefit any graduate and enhance his value to a prospective employer.

Very few colleges give adequate training in what may be termed "human engineering" or human relationships. From the standpoint of the man as a potential executive who has to control other men, it is obvious that a knowledge of some of the basic principles of human relations would be of much value. Many educators agree that the humanities should make up approximately 20 per cent of the curriculum. In a number of colleges the professional studies monopolize almost the entire curriculum, which is usually already much overcrowded. Recently a few institutions have succeeded in the attempt to articulate the humanistic and technical courses into a logical series through which each student, during each quarter or semester, may be given a broad and well-rounded training in the social–humanistic courses. In many instances the humanistic courses are taught by practical teachers. This provision for an adequate number of humanistic courses in the engineering curriculum made it necessary to reduce the number of technical courses and also the contents of many of the courses. Careful scrutiny makes it possible to remove a lot of time-consuming frills from the curriculum, thus not only reducing the number of credit hours but in addition giving the student ample time to master fundamentals. The value of the intensification of courses is becoming more and more apparent.

In conclusion, it may be said that each student should be permitted to lay out, subject to the approval of his faculty adviser or the head of his department, a course of study for himself most in keeping with his goal and

aptitudes and with the industry or field of business activity in which he is most interested. If such a plan of study does not lead toward a degree, then let it lead toward a certificate. An opportunity to make major adjustments in programs of study should be given to those few geniuses or near-geniuses who are so concentrated that they cannot become interested to any great extent in anything but intensive, specialized subjects.

TEACHERS OF COLLEGE STUDENTS

No expense should be spared in obtaining teachers who can teach. Many faculties are made up of too many men primarily interested in abstract research and in writing papers and books (many of which are of little worth), who use their teaching only as a means of livelihood. It is not the intention of this article to underestimate the worth of research and writing; it is, however, endeavoring to call attention to the fact that in general those responsible for the recommendations of promotions and salary increases overemphasize degrees, research, and writing, and almost entirely forget the performance of good teaching for which the faculty members were primarily employed.

A professor who is also head of a department says:

"... For the past few years there has been considerable pressure on faculty people to do research and publish technical papers. This is probably being overemphasized. Our staff members should be good teachers and be able to inspire the students under them to do constructive work. At the same time a good teacher should be interested in research in his field, in making contacts in industry, and in writing such papers as he may feel will be valuable to other teachers or to the industry. The matters of research and publications are in themselves not important—the importance is that our teachers should be wide awake and active in their profession as well as in their teaching. Much can be done to raise the pay scale of teachers in order to attract an improved quality of personnel. I believe that faculty people should be encouraged to do outside consulting work, provided the time required does not interfere with college duties, both curricular and extracurricular, and also provided that they do not enter into unfair competition with existing personnel and agencies. It is also desirable that faculty people participate in industrial work during summer vacation. Staff members should have frequent discussion with students and spend a great deal of time in the counseling of students. The attitude should be that the professor exists for the students and not vice versa."

Those rare individuals who are good teachers, good researchers, and good writers are much too scarce, but every faculty should be made up of as many men of this caliber as possible for the benefit of the students, especially the graduate students.

An astoundingly large percentage of faculty members have not had any training in teaching methods; on the other hand, many with little teaching ability are holding teaching positions because they have taken the required hours of education. To improve methods in instruction, faculty members must be far better trained in teaching methods, and such training must be recognized as of equal importance with the proper mastery of the subject itself. Very few colleges make adequate provision for this training. Colleges have many so-called "teachers," but few *educators*.

A dean of freshmen in a nationally known engineering college says:

"Common complaints are that the instructor comes to class inadequately prepared and therefore does not cover the whole assignment; that he spends too much time on his own pet ideas; that he does not answer questions directly and clearly; that he takes too much time in answering the questions of the more aggressive students and fails to cover all the material of the assignment; that he does not keep regular office hours and does not appear willing to give the students an adequate amount of time outside of the classroom; or that because of inexperience he is unable to express himself clearly before his classes."

Another common complaint from students is that many instructors have had a thorough academic training in a too-narrow field. They are mental giants in their particular grooves and "babes in the woods" when they wander beyond the walls of the rut. They know so much about their own subjects that their imaginations take them into the clouds, and they become impatient with students who do not understand such abstract teaching. Several deans have expressed their sincere interest in employing teachers with a broader training: for example, teachers in mathematics who have bachelors' degrees in science or engineering and doctors' degrees in mathematics; English teachers who have bachelors' degrees in engineering and doctors' degrees with a major in English, and so on. An English teacher with such qualifications would be invaluable to teach engineering students how to write technical reports. An employer of a large number of college graduates states:

"Report writing seems to be one of the 'bugbears' of engineering education. Most of the colleges, in my experience, require the boys to write upon certain forms of paper, in certain size folders, using stereotyped systems, a report of each individual experiment that is performed in the laboratory. I think we hear more growling from the young men about the long hours that they put in writing up this type of report than any other one thing. To me, they are right, and this is more or less a waste of time. If a boy could be taught to clearly outline in his own words, using his own form of presentation, the knowledge gleaned from a complete course involving a full term, he would gain infinitely more from this experience than from the submission of almost daily reports, as is now required. It is only by such expression in his own words that a boy will really remember the things that he has done in his school work, whether it be in the laboratory or in the classroom. I am convinced that many changes could be made in the whole problem of report writing."

If instructors are to keep abreast with the times, they should not only have a thorough academic and pedagogical training and experience, but also practical research and industrial experience in their own and allied fields. Some of the instructors might well exchange places for a time with men in the field. In this way the instructors would not only keep up to date on modern methods and developments, but they would have a keen appreciation of the students' problems after graduation, and new ideas could be brought into the college from industry. To maintain further these outside contacts,

each instructor who has an eager desire to grow mentally should be encouraged to attend worthwhile professional meetings and meetings of business organizations; to visit other universities, industries, and research laboratories; and to contact authorities in his field of work.

Genuine teachers are ready to give students friendly and helpful service at all times. Any instructor who enjoys offending a student for whom the hurdles may seem unusually high should hide his face in shame, yet how often instructors boastfully predict in public that one half of the class will fail by midsemester! Those same instructors are always looking for praise in order to bolster themselves for their own work.

The characteristics of instructors who are designated as good teachers have been summarized as follows:

Knowledge of subject—shown by ability to lecture without a slavish dependence upon notes; by accuracy of thought and conciseness of expression; by an up-to-date and thorough acquaintance, practical as well as theoretical, with the subject; and last but not least, by scholastic attainments

Effective presentation of subject—marked by clear, vivid, enthusiastic but at the same time methodical approach which holds the interest and undivided attention of students, combined with a human and patient persistence with mediocre and poor students

Personal qualities—wholesome attitude and a balanced philosophy of life, alertness, fair-mindedness, courtesy, humor, sincerity, tolerance, neatness—qualities that command admiration and respect and awaken a responsive spirit in the student

General knowledge—culture, knowledge of current events, being well versed in a number of subjects and realizing that his special subject is not the only one of importance in the course of study

Effective class management—good discipline, ability to make students work hard and like it, development of businesslike attitude toward classroom duties and initiative on part of student

Practical experience—commercial and industrial contacts that are an advantage in giving students an understanding of the conditions to be met after graduation and a valuable asset to the teacher in finding employment for students

NEED FOR RESEARCH

The present emergency has revealed the scarcity of men with creative ability. The future will demand extensive research in the solution of pure and applied scientific research problems. The graduate research students will find golden opportunities in the laboratories. Competent members of the staff should be encouraged to carry on research, for its performance brings to light creative ability and originality of thought among the members of the engineering staff and constantly changing student body, especially among graduate students.

The progress of the United States is now as never before depending upon American genius and American ingenuity, through the ever-opening avenues of scientific and inventive processes, to make the most of natural resources and the opportunities offered to a free people.

CONCLUSIONS

The present demand for trained engineers, trained workers, trained minds, skilled technicians, and for individuals with good health and surplus physical energy has placed a new and greater emphasis on education, its objectives, techniques, scope, functions, cost, and sources of revenue for its support.

The American educational system is primarily responsible for:

1. The maximum improvement of the physical, mental, and social aspects of the life of each citizen. This means co-ordination of the activities of the entire school system—elementary and secondary schools, vocational and trade schools, and colleges and universities

2. The provision for each individual to receive the opportunity for just as much education as will be of real benefit to him and as is economically justifiable

3. The teaching of fundamental principles so thoroughly that the individual will always be the master of them

4. The development, as far as possible, in each individual of such virtues as justice, honor, loyalty, honesty, respect, integrity, tolerance, thrift, co-operation, friendliness, and good will

5. Training in citizenship designed to improve the level of civic effectiveness

6. The formulation of concise definitions of the aims of each course offered and its relationship to the other courses in a program of study for an individual preparing for the different trades, occupations, and professions of life

After the aims and objectives of each course and program of study have been concisely and specifically formulated, the next major problem is to select programs which will be of maximum benefit to the individual, making him an asset to his community, state, and nation. A program of study should be selected which is in harmony with the student's mental and physical capacities, personality, mental attitude, character, initiative, and judgment. This might mean terminating study at the end of any quarter, semester, or year, and the receipt of a certificate instead of a diploma.

The admission standards for each program of study should be high, rigid, and adhered to, so that only qualified individuals are admitted, making it unnecessary to have a large percentage of failures. The student who satisfactorily completes a program of study which does not lead to a degree should be awarded an appropriate certificate of achievement. Each student should be made aware of the quality of the standards required of those to whom the schools, colleges, or universities award either certificates or diplomas.

State and national examinations should be provided, graded by outside committees, which would be more impartial and give a check on teachers as well as students. The instructor could then boast about the large percentage of his students who passed, instead of about the large percentage who failed his course under the present system.

The curriculum should be made up of fundamental subjects and fundamental principles, and each subject so taught as to create the habit of understanding thoroughly the subject matter and processes. Each student should be given maximum opportunity to develop

creative thinking. Irrelevant subjects should be deleted from the program of study, and each of the fundamental subjects revised to provide the individual with those fundamental principles that are of paramount value in the trade, vocation, or profession for which he is being trained. The University of Chicago has recognized the necessity for condensation and is now offering a bachelor of arts degree after two years of college work. Over 600 junior colleges in the United States will probably follow the example set by Chicago.

Specialization in professional undergraduate programs of study should be minimized; the graduate student, however, should be allowed to specialize in his chosen field. The student load should be reduced in order to allow sufficient time for a thorough mastering of each subject.

Provisions should be made for more after-college education, whether that be training on the job, graduate studies, or returning to the university after graduation for intensive or broadening courses.

No expense should be spared in obtaining teachers who can teach—individuals who know their subjects thoroughly and are imbued with enthusiasm and a keen interest in the training and development of students. Improved teaching should start with the elementary schools, but it should not end there. To secure it, we should offer greater incentives to those competent individuals who can teach and who are also interested in research and writing. Teachers should not be employed only because they have completed the required hours in education; they should be selected on the basis of mental and physical capacities, enthusiasm, knowledge of subject plus knowledge of related subjects, ability in and love of teaching, personality, sense of humor, interest in students, and character, supplemented by an adequate training in teaching methods. In this way we could disprove the old adage, "Those who can, do; those who cannot, teach."

The physical-plant facilities of a college—classrooms, laboratories, and offices—are of prime importance. During the past few years several colleges have made extensive additions to physical plants. The progressive colleges have desirable facilities and keep them in good condition. Making a greater and more effective use of such facilities is timely and necessary. Many educational institutions are now operating on a continuous wartime basis. This increased use of physical plant will in all probability be continued after the war.

The world crisis, bringing with it many economic and social problems, will have an unpredictable effect upon the colleges. The larger and more progressive institutions will readily adapt themselves to the changing conditions, while many of the smaller and less progressive are bound to face partial if not total collapse.

The colleges throughout the United States made enormous strides after World War I. The present war, too, will end; after which the colleges surviving this trial period will again be in a position to move forward with even greater advances than in the recent past. Because of improved physical-plant facilities in institutions of higher learning, and especially because of new laboratories, scientists have been able to raise the level of experimental inquiry in every region by discovering new methods of acquiring constructive knowledge, the lack of which has prevented rapid progress in the past, and a method of wisely applying knowledge once we have found it. Life always has been full of potentialities not fully developed for want of worthwhile channels of expression; such channels have been and will always be opened by the progressive colleges through the mastery of techniques.

Since the new frontiers of scientific research, invention, organization of production, and extension of service call for more and more college-trained men, there will always be a great need for progressive colleges, especially during the important postwar period of world-wide general reconstruction of an old world with a new society.

The educational system has been guided heretofore by precedent. College administrators and staff members have been imitators rather than initiators. The direction taken by the things that are now going on indicates the real condition toward which the world is moving. It also indicates clearly that the forward movement is the only one of promise and stability. The restudied, the reorganized, the readjusted, and the reconstructed colleges of tomorrow will point the way. Let's take "a backward look for a forward plan" by keeping the worthwhile changes forced upon us because of a world war.

Brazil's Hydroelectric Potentialities

Brazil is one of the richest countries in the world in potential hydraulic or water power. It has been estimated that the potential hydraulic power of Brazil is over 14,000,000 kw, and only about 739,000 has been utilized. According to statistics compiled by the World Power Conference, Brazil ranks fourth in hydraulic power. Russia ranks first, with 58,000,000 kw, the United States is second with 25,000,000, kw, and Canada is third with 19,000,000 kw. Statistics are based on discharge during a low water season.

The State of Minas Gerais has the largest number of hydroelectric powerhouses with the State of Sao Paulo second and the State of Rio de Janeiro third. However, the State of Sao Paulo has the greatest amount of power harnessed.

Brazil has one of the largest powerhouses in the world, located at Cubatao, near Santos, with a 308,000-horsepower installation. It is classified in eighth place according to world statistics on hydroelectric powerhouses.

Excerpt from an article, "Brazil—Arsenal of Strategic Materials," published in the February 21, 1942, issue of *Foreign Commerce Weekly*.

INSTITUTE ACTIVITIES

A Greeting to the Members of the Institute

First I wish to say a word of my appreciation of the great honor of being elected president of the Institute. The office is one of great distinction because it has been adorned by so many of the great names of our profession and also because the AIEE today is a great and very vital institution. Its greatness and vitality come not from size alone but are the result of the activities of thousands of members who express their interest in Institute affairs by carrying out its extensive program.

The honor of being president of the Institute comes to me at a time when the thoughts of all of us are overshadowed by the crisis in world affairs. I am sure that many of the members of the Institute have been thinking as I have of what is the place of the Institute in our world of today.

In many ways the war has greatly complicated our life but in one respect it is simplified. We have a simple criterion to apply to any proposed course of action—a criterion which is expressed in the motto that appears so often on the walls of the offices in Washington, "Will it help win the war?"

During the past year this criterion has been repeatedly applied by the board of directors and by the Institute committees in their planning of Institute activities. With the rapid change in conditions, it seems desirable now to take another look at the plans for all Institute activities for the coming year to see how they can be made most helpful to the war effort. This is being done by the committee on planning and co-ordination who will present their report at the August meeting of the board of directors. In the meantime at the June meeting the board approved recommendations of the technical program committee as to the type of papers to be presented at national meetings providing that all solicited papers shall be closely related to the war effort. These recommendations are reported elsewhere (p. 418) in this issue of *Electrical Engineering*.

While we believe these reviews will suggest ways in which the Institute program can be more closely allied with the war effort, it is not expected that they will cause revolutionary changes. The Institute is the great national forum for the discussion of advances in the electrical arts. Today much that we are doing is confidential and cannot be discussed. Some other topics are related to the war only remotely, and their discussion had better be postponed. Between these two classifications, however, there is a broad range of subjects which it is helpful to discuss at the present time. In this range we have an obligation to pass on information and experience which will help others to meet the responsibilities which the war has placed upon them. In our preoccupation with the urgent tasks of the day it would be easy to overlook this obligation. However, experience at the Chicago convention, where the program was unusually large and a great many of the papers were closely related to the war effort, shows that the members and committees are fully aware of this responsibility.

I should like to say a few words about another responsibility which it seems to me we have—not specifically as members of the Institute, but as members of the engineering profession. Of course, this is fundamentally a soldiers' war, like every war, but the overshadowing importance of production in this war has fastened public attention upon engineering in a way that perhaps has never happened before. As a group, engineers have a closer relation to the war activities than most groups of civilians, because of our close relation to production.

Therefore, we may be more influential than we realize in affecting the point of view of people in general on matters relating to the war. We ought to be able to help maintain those overtones of morale that come from having a real appreciation of the problem.

For example, what do we say in an unguarded moment about priorities and rationing? I suppose, with copper the scarcest of all scarce materials, we who are doing electrical engineering are affected as directly and as deeply by priorities and scarcities as any group of people in the

Harold S. Osborne, AIEE President 1942–43

country. Yet scarcities of things used by everybody are beginning to pinch people in general, and we know that necessarily those scarcities will become more widespread and more severe.

Now the man in the street must not fall into fallacy of thinking of these scarcities as due to the War Production Board or to priorities. We can help him always to bear in mind that the scarcities are due to Hitler. We know, and we can help him to realize, however much the overloaded machinery may creak, that the priorities system is doing a magnificent job, first in insuring that in so far as possible the war program gets the critical materials which it needs, and second in softening the impact of these scarcities upon our lives.

Another way in which I think we can help is by dampening undue waves of optimism or of pessimism with each minor swing of the fortunes of the struggle. While only the Army and the Navy can fully realize the immensity of the job before them, surely we, who are close to the production problem, have enough appreciation of the long sustained effort which is necessary to realize the importance that this effort should be not slackened by undue overconfidence, or by discouragement.

Finally, one more way in which I think we can help is to help maintain the long-range point of view. At the present time all our efforts must be concentrated on winning the war. But after the war is won, we must win the peace. That will mean answering a host of very difficult questions—economic questions, as Past President Prince has brought out so well in his talks on economic readjustments after the war, and international questions relating to reconstruction, and to the maintenance of peace.

It is clear that to get the correct answer to all of those questions will take the utmost that all of us have of wisdom and character. It is too early now to solve those problems. We have another task before us. But as we concentrate our efforts on the immediate task of winning the war, let us jealously guard our ability to take a long-range view and to make an unimpassioned analysis of facts. In all we do, let us hold this ideal before us so that we will be strengthened for these other and perhaps even more difficult tasks that lie ahead.

H. S. Osborne

Schedule of Events

Wednesday, September 9

9:00 a.m.	Registration (daily to 5:00 p.m.)
10:00 a.m.	Address of welcome. System operation session.
12:00 a.m.	Luncheon conference of National District, and Section Officers.
2:00 p.m.	Apparatus I session. Student technical session.
7:30 p.m.	Presidents reception and dinner.

Thursday, September 10

10:00 a.m.	Apparatus II session.
12:00 a.m.	Luncheon conference for students and Branch counselors.
2:00 p.m.	Student technical session. Golf competition for John B. Fisken cup.
9:00 p.m.	Dance

Friday, September 11

10:00 a.m.	System planning session
12:00 a.m.	Joint luncheon with Vancouver Electric Club.
2:00 p.m.	Selected subjects session.

Pacific Coast Convention Program Will Stress Power for War

Arrangements are in progress for the program of the Pacific Coast convention, which will be held in Vancouver, B. C., September 9–11, 1942. Convention headquarters will be in the Hotel Vancouver.

To aid the war effort the local technical program committee is developing a program of a practical rather than a theoretical nature. Most of the technical papers will deal with the problems of power supply and the protective equipment used on power systems and in industry. Tentative plans include six sessions on the subjects of system operation, apparatus, system planning, and selected subjects.

Two student sessions will be held, in which it is expected papers will be presented by the students. In addition, a dinner and conference will be held for all students and Branch counselors of Districts 8 and 9.

As is to be expected, the entertainment will be mainly in the evenings. However, there will be an opportunity for sightseeing, with entertainment for the visiting women. One of the afternoons will be devoted to the annual golf competition for the John B. Fisken cup.

ADVANCE REGISTRATION

Members who receive an advance registration card with the mailed announcement of the convention should register in advance by filling in and returning the card promptly. This will permit the committee to have badges ready and prevent congestion at the registration desk upon arrival. A registration fee of $2 will be charged all nonmembers except Enrolled Students and the immediate families of members.

Hotel reservations should be made by writing directly to the hotel preferred.

The personnel of the 1942 Pacific Coast convention committee making the arrangements was announced in *Electrical Engineering* for July, page 358.

Pacific Coast Convention

Wednesday, September 9

10:00 a.m. System Operation Session

42-146. A Practical Discussion of Problems in Transformer-Differential Protection. **P. W. Shill,** British Columbia Electric Railway Co., Ltd.

42-153. Three-Winding Transformer Ring Bus Characteristics. **G. W. Bills, C. A. MacArthur,** Bonneville Power Administration

CP.* Automatic Tie Line Load Control Application to the Northwestern Electric Company's System. **Owen W. Hurd**

2:00 p.m. Apparatus I Session

42-157. Some Air-Blast Circuit Breaker Installations in Canada. **H. W. Haberl,** Montreal Light, Heat, and Power Consolidated, and **R. A. Moore,** English Electric Company of Canada, Ltd.

42-155. Design and Operation of High-Voltage Axial Air-Blast Circuit Breakers. **Armin K. Leuthold,** Brown Boveri and Swiss Electric Company of Canada, Limited

42-148. Design, Manufacture, and Installation of 120-Kv Oil-Filled Cables in Canada. **D. M. Farnham,** Montreal Light, Heat, and Power Consolidated, and **O. W. Titus,** Canada Wire and Cable Company, Ltd.

● **PAMPHLET reproductions of authors' manuscripts of the numbered papers listed in this program may be obtained as noted in the following paragraphs.**

● **ABSTRACTS of papers appear on pages 433–4 of this issue.**

● **PRICES and instructions for procuring advance copies of these papers accompany the abstracts. Mail orders are advisable, particu-**

42-151-ACO.† Some Canadian Developments in Relays and Relay Applications. **E. G. Ratz,** Canadian Westinghouse Company, Limited

Thursday, September 10

10:00 a.m. Apparatus II Session

42-118. Ignitron Rectifiers in Industry. **J. H. Cox** and **G. F. Jones,** Westinghouse Electric and Manufacturing Company

Engineer's Part in Solving Wartime Problems Featured at 1942 Summer Convention

Any lingering questions as to the value of or interest in AIEE convention programs and the opportunities offered thereby for the first-hand discussion of wartime engineering problems should be dissipated conclusively by the results of the recent summer convention in Chicago. As at the recent Northeastern District meeting at Schenectady, N. Y., the attendance set records for recent years, and participation in the various discussions and conferences was active.

As in the past years, at the technical sessions, which in many cases were keyed to specific engineering problems arising from the war production program, technical problems were discussed and new developments in engineering design and application were disclosed. Among the significant features of the non-technical meetings were the address, "Democracy in Its Struggle Looks to the Engineer," presented at the annual meeting by D. D. Ewing, head of the school of electrical engineering at Purdue University, and a challenge to the postwar engineer, "The Engineer's Last in a Postwar World," by AIEE President Prince, vice-president in charge of application engineering, General Electric Company.

This year's convention, at the Drake Hotel, June 22–26, was the 58th annual summer convention of the Institute and the fifth to be held in Chicago. (Others—1933, 1924, 1911, and 1892.) The total verified registration of 1,179 is of record proportions, having been exceeded only twice in the history of AIEE summer conventions. An analysis and comparison of registration figures are given in the accompanying tabulations.

Attendance at technical sessions ranged from 40 to 200, averaging more than 100 at a session. Conference sessions were attended by an average of over 55. Interest in AIEE affairs was evidenced by an attendance of 200 at the annual meeting, and the appeal of general topics was indicated by an attendance figure of 300 for the general session. Such reports of technical conferences as were available appear elsewhere in this issue, as also does the substance of the annual conference of officers, delegates, and members.

Annual Business Meeting

The annual business meeting of the American Institute of Electrical Engineers convened at 10 a.m. on Monday, June 22, 1942, in the ballroom of the Drake Hotel in Chicago, Ill. H. B. Gear welcomed those present and introduced D. D. Ewing, as principle speaker. Following his address, the official business session was convened by President Prince, who called upon H. H. Henline, National secretary, to present high lights from the current annual report of the board of directors. This report was published in full in the July 1942 issue of *Electrical Engineering*, pages 368–81. Mr. Henline also reported on the activities of the Sections and Branches, concerning which a report was published in the June 1942 issue of *Electrical Engineering*, pages 322–3.

SECRETARY'S REPORT

Among the salient points of the annual report as given by Mr. Henline were the following:

During the current administration year the number of AIEE Sections reached a total of 72. The board of directors last January decided to assign to the existing Sections all remaining parts of the United States so that members in all areas of the United States are now included in some Section. AIEE membership, he said, reached a total of 18,094 at the end of the fiscal year, and a total of 19,065 on the first of June. These figures are far higher than any membership before the depression.

1942–43 OFFICERS ANNOUNCED

Following the reading of the annual report, Mr. Henline gave the report of the committee of tellers, including a complete list of the officers of the Institute for the administration year beginning August 1. Essential substance of this report was published in the July 1942 issue of *Electrical Engineering*, page 358. As is customary at this point in the annual meeting, President Prince welcomed Doctor H. S. Osborne of the American Telephone and Telegraph Company as president-elect of the Institute for the year 1942–43.

TREASURER'S REPORT

W. I. Slichter, treasurer, summarized and confirmed the official report of the auditors, which has been printed as a part of the annual report of the board of directors. The gross income of the Institute for the fiscal year ending April 30, 1942 was $344,901.81 as compared with $318,684.13 for the previous year, while expenditures for the past fiscal year amounted to $320,748.82 as compared to $299,222.81 for the previous year. Surplus for the year totaled $24,262.06. The total reserve, capital fund for the fiscal year ending April 30, 1942, Mr. Slichter reported to be $251,211.20 in comparison with the previous year's amount of $220,255.69. In these days, he pointed out, the investment of such funds is a difficult matter, and the finance committee has found it advisable to keep a certain amount of these funds in a liquid condition so that the Institute may be prepared later for the change from war to peace. Therefore, the committee has kept in quick assets, short-term government securities amounting to $119,534.94 and cash in banks amounting to $35,520.87, giving a total of $155,055.81.

PRIZES AWARDED

P. L. Alger, chairman of the committee on award of Institute prizes, announced the winners of national prizes awarded for papers presented during 1941, and President Prince presented the awards. The report of the committee on the award of Institute prizes appears as a part of the report of the board of directors (see *EE, July '42, p. 377*). This is further supple-

Technical Program

larly from out-of-town members, as an adequate supply of each paper at the convention cannot be assured. Only numbered papers are available in pamphlet form.

● ALL PAPERS regularly approved by the technical program committee ultimately will be published in Transactions; many will appear also in Electrical Engineering.

42-138. Electrical Equipment for Large Electrochemical Installations. **T. R. Rhea** and **H. H. Zielinski**, General Electric Company

42-156. Interim Report on Guides for Overloading Transformers and Voltage Regulators. Transformer subcommittee of committee on electrical machinery.

CP.* An Analysis of the Allocation of System Investment Charges to Kilowatt and Kilovar Requirements. **J. W. Butler**, General Electric Company

Friday, September 11

10:00 a.m. System Planning Session

42-150. Power-System Interconnection in Quebec. **W. R. Way**, The Shawinigan Water and Power Company

42-149. Method for A-C Network Analysis Using Resistance Networks. **Waldo E. Enns**, Portland General Electric Company

42-158. Inverse Functions of Complex Quantities. **H. B. Dwight**, Massachusetts Institute of Technology

2:00 p.m. Selected Subjects Session

42-152. History of A-C Wave Form, Its Determination and Standardization. **Frederick Bedell**, R. C. Burt Laboratory

42-147. A New Single-Pole Service Restorer. **E. E. Tugby**, Pacific Electric Manufacturing Corporation

42-154. Application of Vacuum-Tube Oscillators to Induction and Dielectric Heating in Industry. **J. P. Jordan**, General Electric Company

*CP: Conference presentation; no advance copies of papers available; not intended for publication in *Transactions*.

† ACO: Advance copies only available; not intended for publication in *Transactions*.

Analysis of Registration at 1942 Summer Convention, Chicago, Ill.

Classification	Districts 1	2	3	4	5	6	7	8	9	10	Totals
Members	70	149	71	24	473	7	34	9	9	9	855
Men guests	11	17	6		106	2	4	1			147
Women guests	9	27	19	9	97	3	8	2	2	1	177
Totals	90	193	96	33	676	12	46	12	11	10	1,179

mented by information on District prize awards published on page 360 of the July issue of *Electrical Engineering*.

LAMME MEDAL TO F. E. RICKETTS

The 1941 AIEE Lamme Gold Medal was awarded to Forrest E. Ricketts (A'16) vice-president of the Consolidated Gas, Electric Light, and Power Company of Baltimore, Md. On behalf of the Lamme Medal committee, C. A. Powel outlined the basis of the award and gave a brief address on some of the outstanding points of the career of the donor, Benjamin Garver Lamme.

Nicholas Stahl, chief engineer of the Pennsylvania Power and Light Company, introduced the Medalist Ricketts, giving an account of his life and accomplishments, to which Mr. Ricketts responded, after presentation of the medal by President Prince. Text of these addresses appear on pages 397–401 of this issue.

Other Convention Features

An unusual feature of the 1942 summer convention was a special AIEE wartime broadcast over the Columbia Broadcasting System from Chicago on the evening of June 25, bringing together Brigadier General Donald Armstrong of the United States Army Chicago Ordnance District, D. C. Prince, AIEE president, and H. B. Gear, general committee chairman of the convention and vice-president of the Commonwealth Edison Company, in a program which was designed to convey to the public the vital part of American industry the battle of production and especially to show how electricity is fighting the war.

ENTERTAINMENT AND SPORTS

Successfully carrying out a feature that has proved effective at some previous summer conventions, the Chicago Committee arranged for a preconvention reception for early arrivals. This affair was held in the Drake Hotel Sunday evening, June 21, beginning at about 6 p.m. and lasting until after 8 p.m. Refreshments were served informally, buffet style, with members of the ladies' committee acting as hostesses. The attendance exceeded 100.

The president's reception was held in the Tower Room of the Drake on Monday evening, June 22, and was followed by a dance, sponsored by the Chicago Section, in the Gold Ballroom.

Another high light of the war-limited entertainment features of the summer convention was the Tuesday evening affair held at the Lake Shore Club. Located just three short blocks from the Drake Hotel, convention headquarters, the Lake Shore Club was easily reached on foot, thus avoiding transportation difficulties. The evening's affair started with the progressive serving of a substantial buffet meal to the 500 persons attending from about 7 p.m. until after 9 p.m. Entitled "Beaches and Boulevards of Central and South America," the evening's program featured double-header, all-star programs, carried on in parallel so as to divide the crowd and avoid congestion. The major feature comprised an hour-long revue including clowning, tight-rope performers, and musical variety, all of exceptional excellence. The minor feature embraced a very high-quality aquatic display in the luxurious pool of the Lake Shore Club featuring various individual stars and teams of highly proficient water-ballet performers, principally of the Lake Shore Club. In general the evening was reminiscent of the highly successful Hart House social evening staged on the grounds of the University of Toronto by the Toronto convention committee in 1941, and was equally highly spoken of as the high spot of the convention's entertainment features.

Because of wartime curtailment it was not possible to arrange for the customary technical inspection trips. Sports events this year were limited to the annual golf tournaments for the Mershon cup and the W. S. Lee trophy, both of which were won by H. G. Schultz (A'26) supervising field engineer of the Commonwealth Edison Company, Chicago.

Recent Summer Convention Attendance

1942	**Chicago, Ill.**	*(5)	**1,179**
1941	Toronto, Ont., Can.	(10)	1,203
1940	Swampscott, Mass.	(1)	1,014
1939	San Francisco, Calif.	(8)	940
1938	Washington, D. C.	(2)	825
1937	Milwaukee, Wis.	(5)	1,067
1936	Pasadena, Calif.	(8)	715
1935	Ithaca, N. Y.	(1)	904
1934	Hot Springs, Va.	(4)	351
1933	Chicago, Ill.	(5)	968

* District numbers in parentheses.

Annual Conference of Officers, Delegates, and Members Held at Chicago

The annual conference of officers, delegates, and members was held on the afternoon of June 23, 1942, during the recent AIEE summer convention at Chicago, Ill., with M. S. Coover, chairman of the Sections committee, presiding. A report on the Engineers' Council for Professional Development was a feature of the meeting, which opened with a talk by AIEE President D. C. Prince. Reports were presented by the chairmen of the Sections committee and the technical program committee, and the meeting concluded with extensive open discussion on two main themes—the timely subject of Section activities to aid the war effort, and the perennial topics of attendance at Section meetings and relations between Sections and Student Branches.

President Prince presented a brief résumé of impressions that he had gained from his tours of visits to Sections and Branches during the past administrative year. He emphasized briefly the dual nature of the job now facing engineers as a group: (1) the technical and operating problems of industry in its concentrated war effort; (2) the responsibility as individuals to take part in local affairs to help provide the stable guidance needed, at the same time to give thought and attention to the need for constructive planning for the future to be sure that we preserve the goal for which the nation now is fighting.

Vice-Chairman and Secretary W. B. Morton reported briefly on the actions and recommendations of the Sections committee meeting held during the 1942 winter convention (*EE, Mar. '42, p. 161*).

Chairman P. L. Alger of the technical program committee called attention to the desirability of directing the efforts of the Institute—local Sections, technical committees, District meetings, national conventions—toward maximum contribution to the war effort. He summarized the proposed plans and policies of the technical program committee for the coming year as follows:

1. All technical programs and papers should be closely related to the war effort. The chairmen of technical committees will be expected to submit evidence of the value of all recommended papers in this connection before their programs can be approved.

2. In general, programs should present practical recommendations, or results of experiences, in the form in which they may be of most use to those engaged in war production or planning.

3. To supplement restricted attendance at conventions, conferences may be held at centers of specialized activity, whereby those attending may see the work in which they are interested, and the group as a whole will have the least traveling to do.

4. Papers of insufficient value to the war effort to warrant acceptance at this time, and papers which cannot be published for censorship reasons, will be held in abeyance for presentation and publication after the emergency.

SOUTH AMERICAN SECTIONS CONSIDERED

Chairman Coover reported that within the past year all remaining territory within

the continental United States had been assigned to Sections. This is an objective toward which the Sections committee, following out various recommendations from the annual conferences of officers, delegates, and members, had been working for some time. Thus, any new Sections formed hereafter will have to draw their territory from existing Sections, and proposals of necessity will be considered accordingly.

Chairman Coover reported also that currently there is under way an investigation into the possibilities of forming one or more Sections in other countries of the Western Hemisphere in which there are substantial numbers of AIEE members. In addition to the three Sections in Canada (Toronto, 1903, Vancouver, 1911, Saskatchewan, 1925), and the Mexico Section (1922), there are at present concentrations of members in Cuba, Argentina, Brazil, Chile, Columbia, and Venezuela that suggest the possibility of strong local Sections, depending entirely, of course, upon local interest and local option. The Sections committee currently is corresponding with members in these areas, and expects reasonably soon to be able to formulate specific recommendations based upon suggestions received from these members. The initial response is enthusiastic and it seems reasonable to expect some definite developments, perhaps within the next year.

ECPD EXPLAINED TO DELEGATES

An excellent and illuminating exposition of the objectives and procedures of Engineers' Council for Professional Development was given in a report prepared by James F. Fairman, New York, N. Y., one of the AIEE representatives on ECPD Council. Mr. Fairman's active and constructive participation in ECPD affairs on behalf of AIEE has placed him in a position to give the clear and compelling view of ECPD that is provided in the report published in full elsewhere in this issue. In Mr. Fairman's absence, Vice-President E. S. Lee, another active AIEE representative on ECPD, very effectively and inspiringly presented the report.

SECTION ACTIVITIES IN THE WAR EFFORT

Various suggestions were made concerning the methods and procedures for making AIEE Section meetings more effective, both to members and in the general pursuit of the nation's war effort.

A. E. Knowlton, speaking on behalf of AIEE committee on industrial power applications, urged local Sections to give attention to the problems of industrial engineers and, wherever feasible or productive, to hold special meetings, round-table conferences, or clinics, on electrical problems incidental to the application, operation, and control of equipment in war industries that do not have the benefit of self-contained engineering organizations. This proposal was specifically endorsed by Chairman Alger of the technical program committee.

Chairman-Elect Clyde C. Whipple of the New York Section briefly reviewed the experiences of that Section in its collaboration with other engineering groups and the War Production Board in the holding of a recent "production clinic" in Newark, N. J. Attendance at that conference was developed through the medium of notices sent to the membership of the New York metropolitan Sections of the several national engineering societies, with the result that primarily the engineers from these societies attended, and not enough of the engineers from local small industries, toward which the conference was specifically aimed. Mr. Whipple reported that the New York Section in collaboration with the local sections of other societies was contemplating the establishing of a joint board of engineering consultants, whose services would be available to representatives of small industry as a contribution of the national engineering societies in that area. This project is to be considered further during the coming year.

Methods of stimulating attendance at meetings of local Sections ranged all the way from door prizes to better programs. Representatives from some Sections reported that they had had satisfactory results from such artificial stimulants as door prizes. Other Section representatives reported that they had been able to develop and maintain satisfactory attendance by a schedule of meetings programs related to local problems of interest to engineers. Several Sections do not try to draw all members to all meetings, but concentrate in each meeting on a technical subject of some direct interest to one group of members, thus enabling more penetrating and effective treatment of the selected subject matter; other groups are served at different times during the year by similar concentrations on other topics. Specifically the Pittsburgh Section reported such a plan for the coming year.

Chairman H. W. Bibber of the committee on Student Branches challenged each local Section to make special effort to co-operate with local Student Branches during the ensuing year. With special reference to the "fellowship dinners" which a good many Sections hold once each year as host to local Student Branches, Professor Bibber pointed out that several Sections had greatly enhanced the value of such contacts by arranging for an individual Section member to be the individual host of some student member and limiting tables to three or four such pairs. Professor Bibber urged that this practice be followed by more Sections as compared with the more common practice of inviting students to attend and allowing them to stick together all evening as a relatively isolated group.

A particularly valuable suggestion was made by the representative of the Washington Section who pointed out that one secret of the strength of the Washington Section lay in its definite arrangements for giving a maximum number of Section members something definite to do. This lightens the burdens of committee memberships and stresses the valuable idea of individual participation.

Chairman Coover urged all Sections to make some special and appropriate arrangement at least once each year to give direct and specific recognition to: (1) Enrolled Students who complete their transfer to the grade of Associate; (2) members who complete their transfer to a higher grade of membership.

Aid to ECPD in Promoting Guidance for Young Engineers Discussed at Chicago

At the AIEE summer convention conference of officers, delegates, and members on June 23, 1942, Chicago, Ill., "What the Sections Can Do to Assist ECPD" was the subject of an address by J. F. Fairman (F'35) AIEE representative on Engineers' Council for Professional Development. The essential substance of the talk, which was delivered by E. S. Lee (F'30) in the absence of Mr. Fairman, is as follows:

Engineers' Council for Professional Development is a conference of engineering bodies organized to enhance the professional status of the engineer through the co-operative support of those national organizations directly representing the professional, technical, educational, and legislative phases of an engineer's life. The participating bodies are the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Chemical Engineers, the Society for the Promotion of Engineering Education, the National Council of State Boards of Engineering Examiners, and The Engineering Institute of Canada.

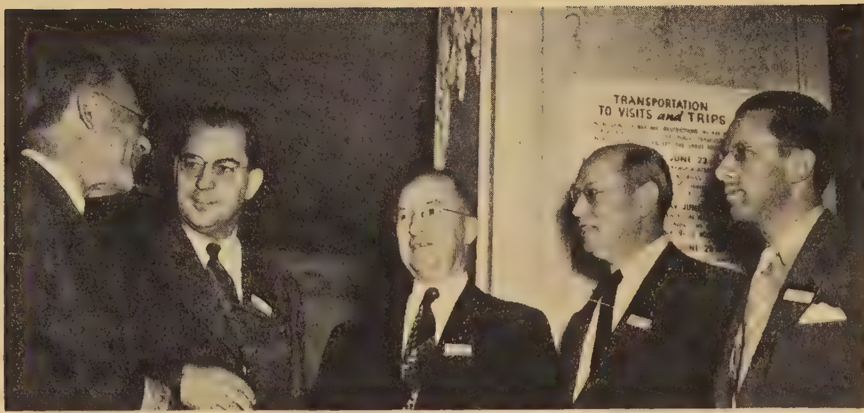
WHAT ARE ECPD'S OBJECTIVES?

The purpose of ECPD as quoted from its charter, "is the enhancement of the professional status of the engineer. To this end it aims to co-ordinate and promote efforts and aspirations directed toward higher professional standards of education and practice, greater solidarity of the profession, and greater effectiveness in dealing with technical, social, and economic problems. "An immediate objective . . . . is the development of a system whereby the progress of the young engineer toward professional standing can be recognized by the public, by the profession, and by the man himself, through the development of technical and other qualifications which will enable him to meet minimum professional standards."

WHAT IS ECPD'S PROGRAM?

ECPD's program consists of four parts:

1. The development of further means for the educational and vocational orientation of young men with



Several widely separated geographical Districts of the Institute are represented in this group conferring informally at the AIEE summer convention at Chicago. Shown here are, left to right: Alexander Dorjikow (M'41), engineer, Bonneville Power Administration, Portland, Oreg.; A. C. Monteith (M'40), manager, industry engineering department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.; R. T. Henry (F'33), assistant chief electrical engineer, Buffalo, Niagara and Eastern Power Corporation, Buffalo, N. Y.; C. F. Wagner (F'40), manager, central-station engineering, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.; J. R. North (F'41), electrical engineer, Commonwealth and Southern Corporation, Jackson, Mich.

respect to the responsibilities and opportunities of engineers in order that only those may seek entrance to the profession who have the high quality, aptitude, and capacity which are required of its members.

2. The formulation of criteria for colleges of engineering which will ensure to their graduates a sound educational foundation for the practice of engineering.

3. The preparation of plans for the further personal and professional development of young engineering graduates, and also of those without formal scholastic training.

4. The development of methods whereby those engineers who have met suitable standards may receive corresponding professional recognition.

It appears necessary to emphasize this program because it seems clear to those who are connected most closely with ECPD's work that before Engineers' Council for Professional Development can accelerate its progress toward the objective stated in its charter, it is essential that not only the officers and boards but the rank and file of the constituent organizations understand much more fully than they have in the past what these objectives are and the importance of their achievement to the welfare of the engineering profession.

An astonishing number of people, including some comparatively close to the work, have felt that the most important activity and the only significant achievements of ECPD have been in connection with the accrediting program. Yet the charter clearly indicates other purposes and activities—relating to selection and guidance, professional training, professional recognition—and these are also actively pursued by standing committees. From the point of view of further advancement of the profession, and more important still, the welfare of the country, these other purposes and activities are in the long run unquestionably of equal importance with accrediting. Good students are not less essential than good schools. Hence, it seems necessary and desirable for the representatives of the participating bodies to conduct an educational campaign among their respective organizations, as one of the most important projects to be undertaken by ECPD.

AROUSING INTEREST OF AIEE

The Institute's representatives on ECPD have suggested that the way to achieve understanding of and active interest in the purposes of ECPD by the members of the constituent organizations is to have the local sections or chapters take an active hand; and that one way to bring this about is to have the whole matter, including a plan, discussed at this conference of officers, delegates, and members of the Institute who are among those responsible for Section activities, for if they understand the plan and are *convinced* of its value, something will come of it when they go back home. AIEE representatives on ECPD believe that the field in which the local Sections might become most active is that of selection and guidance. This work might be patterned along the lines of the procedures already developed in certain metropolitan areas in connection with the work of the ECPD committee on student selection and guidance. Once this is under way, a second step taken by a Section might be in relation to the work of the ECPD committee on professional training in helping young graduates to become appropriately oriented and active in their own professional development.

STUDENT SELECTION AND GUIDANCE

The ECPD committee on student selection and guidance endeavors to develop means for the educational and vocational orientation of young men with respect to the responsibilities and opportunities of engineers, in order that only those may seek entrance to the profession who have the high quality, aptitude, and capacity which are required of its members. This is a very tangible activity in which local Sections can participate. Many are already doing so.

Engineers in several localities have begun to realize the importance of student guidance, and those who have participated have been stimulated by the experience. The counseling of young aspirants for engineering training has a definite bearing on the future membership of the engineering profession and of engineering societies. It is also a civic service and is destined to pay real dividends in every community where it is given a fair trial. The organization of committees of engineers, representing all branches of engineering, to co-operate with high-school guidance officers is continuing slowly, but the results already obtained have been of such value that other communities should be encouraged to recognize and grasp this opportunity which is open to them.

A joint appeal was made to local sections of engineering societies supporting ECPD by the committees on professional training and on student selection and guidance. Replies were received from 50 local sections and city organizations of engineers.

The following citations briefly set forth the experiences disclosed by the replies:

Sections of the leading engineering societies within the metropolitan area of New York, acting jointly, have the largest guidance program with fine support from the societies, the school authorities of greater New York, high-school boys, and their parents.

Requests to extend the program to neighboring areas have been made but lack of funds limits the distance to which speakers can be asked to go at their own expense. Neither expenses nor fees are paid for services. Approximately 100 engineers participated last year in visits to 25 high schools, and assisted 2,000 students in learning what engineering is and what it "takes." Some 5,000 additional boys attended of their own volition to hear the general talks which preceded the more intimate group discussions.

Baltimore, Md., originated some years ago a program of co-operation between education, industry, and engineering in which the Engineers' Club was a leader. The Baltimore committee not only has assisted in counseling in the high schools but has "examined critically the objectives and results of the city's vocational schools in the light of industrial needs." The committee also "instituted studies relative to available jobs and educational requirements, relations of one job to another, and a state-wide job-analysis survey." This constitutes constructive civic service.

In Atlanta, Ga., it has been the practice for engineers to speak to seniors in the secondary schools. It is reported that "a symposium is held and later those boys who are still interested are divided according to the branch of engineering in which they seem interested; representative engineers meet with each group giving information and advice. Individual interviews are then scheduled for those who desire them."

The Washington, D. C., section of The American Society of Mechanical Engineers favors a guidance program and adds, "Pre-engineering guidance is very important. Too many students of mediocre ability enter college for engineering training. At least half of them should enter good trade schools instead."

Another comment: "Guidance should be down to earth. Boys want to know about salaries, prestige, where they can get to, what various types of engineers do. One of the main features of the program should be to guide boys away from engineering who don't belong."

The Engineers' Club of Dayton, Ohio, has sponsored guidance programs. Cincinnati, Ohio, is well served by engineer counselors. Exceptional programs are supported by The Engineering Society of Detroit; by the Colorado Engineering Council which organizes and supervises guidance programs in Denver and other cities. The Nebraska Engineering Society and the Engineers' Club of Omaha (Nebr.) have continued their efforts. The Iowa Engineering Society has continued its unique plan of bringing each high school into contact with the society and state institutions teaching engineering.

Birmingham, Ala., has an able committee of industrial leaders and educators which attempts to provide the leading cities of Alabama with effective engineering guidance. Such generous and enthusiastic civic service deserves recognition.

Memphis, Tenn., and the states of Mississippi and Louisiana have shown an interest in the organization of guidance groups.

St. Louis, Mo., through Doctor Jules Bebie, consulting chemical engineer, has begun to offer additional facilities besides those offered by the Young Men's Christian Association.

The Engineering Institute of Canada has been organizing guidance for some time and is now publishing a booklet of about 30 pages entitled, "The Profession of Engineering in Canada—Information for Prospective Students." This booklet includes sections on engineering in Canada, and on each of the leading subdivisions of engineering. H. F. Bennett, the chairman of the committee which prepared the booklet, is a member of this committee of ECPD.

Obviously the engineering societies, national, state and local, are one of the best means of reaching the high-school boy who is considering engineering as a lifework. These agencies are a first line of offense for prosecuting the purpose of guidance. Hence we make our appeal to you to organize a guidance committee, if you have not already done so, and if you have, to expand and carry on this work as vigorously as possible. This work cannot reach out into the smaller communities without the aid of local groups of practicing engineers. Michigan, Nebraska, Colorado, Iowa, and Alabama are carrying on statewide activities. This is the ultimate goal.

GUIDANCE MANUALS ARE AVAILABLE

ECPD has published a booklet entitled "Engineering as a Career" which is used in these guidance activities. This booklet was prepared particularly for young men, parents, teachers, and others interested in educational guidance to give something of an introductory insight into the profession of engineering. Copies have been widely distributed to high schools, local engineering organizations, and others who are or should be interested in guidance activities. Each section should have received one but if it has been lost or mislaid, another copy can be obtained from AIEE headquarters. Additional copies are available at a price of 10 cents per copy or $7.50 per 100 copies. A second manual intended to guide the guiders has been used in mimeograph form for several years. It is now being printed and will shortly be available. This manual describes the methods which have been found most effective. Copies of this may also be obtained from AIEE headquarters.

PROFESSIONAL TRAINING

Work in the field of professional training is not so far developed as that of student guidance but a good start has been made both by the ECPD committee and certain local groups. E. S. Lee is now chairman of ECPD's committee which is studying and promoting this project. This committee has just begun work on a manual similar to the booklet, "Engineering as a Career," but intended to give the young engineer guidance during his formal educational period and during the apprenticeship or interneship that follows immediately thereafter.

Additional activities of the ECPD committee on professional training include plans to make engineering periodicals available to members of constituent societies who are in the Service by having the publications sent to regularly established Service libraries, either direct from the society, or from individual members. The latter is the plan of the AIEE (see *EE, July '42, p. 359*).

SUGGESTIONS FOR LOCAL ORGANIZATION

In closing I should like to make a few suggestions which may be helpful to those who have started or who are planning to start some local activity in these two fields. In the first place, ECPD is not organized and should not be organized to enter the local field. There are quite enough local engineering organizations already. However, the committees of ECPD will help in any way they can by answering questions, by supplying information as to the experiences of other local groups, and by making suggestions based on their observations. Requests for information may be addressed to the chairman of any ECPD committee or to H. H. Henline, AIEE national secretary, who is also secretary of ECPD. He will see that such requests are directed to the proper committees.

Co-operation with the other local engineering groups is important. On the other hand, failure to arouse their interest should not prevent starting this activity. Invariably they will be glad to join as soon as the full significance of the endeavor becomes clear to them.

In the case of guidance activities it is vital that the co-operation of the school authorities be obtained. It should be made clear to school superintendents, high-school principals, and school guidance counselors that you have nothing to sell, that you are not agents for a particular college, that you are not trying to interfere with their work, but that you will be glad to assist their students in making a wise choice of vocation by giving information, answering questions, and helping each boy make an intelligent measure of his adaptability, interest in, and preparation for an engineering career. No definite rules can be laid down. Each local situation must be handled on its merits and according to its needs. The type of organization and method of operation must be adapted to the local situation. In the work that has been done thus far, the local Sections of the Institute have in general been leaders. May they continue so.

AIEE Participation Urged for WPB Industrial Salvage Program

Co-operation by the Institute as an organization and by Institute members as individuals in the industrial salvage program set up by the War Production Board was solicited by George Sutherland of the WPB Bureau of Industrial Conservation, speaking at the general session on June 25, 1942, of the recent AIEE summer convention at Chicago, Ill.

As an organization, operating through its committees and especially through its local Sections, AIEE should co-operate in and emphasize the importance of the salvage program of the WPB, stimulating it and improving its effectiveness in every way in every possible locality, Mr. Sutherland declared. As individual members of the AIEE, every person should make himself a committee of one to promote the effectiveness of the salvage program, in his business connections as well as in his home and community connections and activities.

Describing the organization of the Bureau of Conservation, Mr. Sutherland explained that originally it included five sections, three of which were concerned with conservation of new materials, through simplification of designs, standardization, and substitution, and two sections concerned with salvage—one handling the general salvage program, and the other with industrial salvage only. He described the general salvage section as "the Hallelujah Chorus—the group that works on the general public, to induce people to save and contribute small individual quantities, which in the aggregate make a substantial contribution to the amount of material required." This section handled the drive for scrap rubber. A special division of this section has been set up to handle specialized projects that require elimination of legal entanglements, such as taking up rails no longer used by street railways, and another special division is concerned only with "automobile graveyards."

The industrial salvage section, Mr.

Sutherland explained, operates in two ways: (1) through industrial centers, by sending its staff members to organize salvage operations throughout a whole industrial community; and (2) vertically in individual industries, by having one man in charge of organizing salvage throughout an entire industry. He reported progress by both methods. "The scrap is coming in, and the work of making people scrap-conscious is being effective," he declared.

In response to a question from President Prince concerning the possibility of a formula for determining under what conditions the machinery normally required for industrial peacetime production but now standing in storage at most industrial plants should be classified as scrap and turned in or held in reserve for postwar production, Mr. Sutherland pointed out that no formula was possible. He suggested that where any such machinery had been idle for even as little as five years, or where there was any likelihood at all of postwar changes in model or design of product, the machinery in question would be more valuable to the nation if turned in for scrap now and replaced after the war with modern equipment adapted to the circumstances that then will prevail.

INDUSTRY FORMS SALVAGE COMMITTEE

Formation of the American Industries Salvage Committee, representing groups of leading industrial concerns who are working with the Conservation Division of the WPB to help speed the collection of vital scrap materials, has been announced by Robert W. Wolcott, chairman of the group and president of Lukens Steel Company. The work of the committee, backing up a broad advertising program, will be: (1) to reach every manufacturing and business firm in the nation to emphasize the absolute necessity of getting scrap on the way to the production line; and (2) to get businessmen cooperating with the local salvage committees of the WPB already set up in 12,000 communities. The activities of the committee will be closely co-ordinated with the present intensified scrap collection drive of the WPB, according to Mr. Wolcott. In this connection, the committee is underwriting the cost of an extensive national advertising campaign approved by the WPB, with a number of major industries underwriting the costs. The advertising being carried on in newspapers, magazines, farm and trade papers, and on the air, focuses the spotlight of public attention upon the need for iron and steel scrap, nonferrous metals, rags, burlap, rubber, tin cans (in some localities), waste cooking fats.

Supplementing contacts with industry already established by the Industrial Salvage Division of the WPB, the American Industries Salvage Committee will make a direct approach to individual industrial concerns, working through industry chairmen who are now being appointed. Leaders in fifty industries are being asked to serve as chairmen for their respective trades in a broad effort to see that every company appoints a salvage manager with authority not only to clean out production scrap, but also to junk obsolescent equipment.

Organization and Management of Engineering Described at Unusual General Session

An innovation in Institute convention programs which attracted marked interest was the general session of the summer convention Thursday morning, June 25, 1942, on the subject of "The Organization and Management of Large-Scale Engineering Works" at which President D. C. Prince presided. Reflecting the increasing degree to which engineers are taking on managerial functions, various aspects of engineering organization were presented by executives representing communications, electrical manufacturing, and public utilities.

M. R. Sullivan, vice-president, American Telephone and Telegraph Company, New York, N. Y., the first speaker in this symposium pointed out that the glamour associated with the recent and startling developments of science has kept the public from realizing that "until a competent organization takes the results of scientific research and translates them into products and services, the public gets little good from the research." Mr. Sullivan emphasized, as did the other speakers, the importance of administration and executive direction, calling attention to the fact that in the Bell System one out of every eight employees occupies a supervisory position.

Organizational and personnel policies of the General Electric Company were described by R. C. Muir (F'36) vice-president of that company, Schenectady, N. Y., who said the aim had been to achieve both directness of action by the whole organization and freedom of action for individual engineers and engineering groups, and to do this without conflict. Among the principles he mentioned as underlying the organizational setup were: that form of organization should be subordinate to personnel; that responsibility should always carry corresponding authority; that a "runner up" should always be available for each important position, so that no unexpected loss of one person can seriously embarrass or disrupt operations; that organization and development of personnel should be specifically planned, looking ahead for 15 years or more.

The relation of engineering management to the over-all management of a large public utility was discussed by H. B. Gear (F'20), vice-president, Commonwealth Edison Company, Chicago, who cited his experiences as a young engineer in helping to bring order out of the chaos of conflicting systems and methods at the beginnings of utility development, as an example of the contribution engineering makes to the management of an enterprise. He stressed the engineer's need to see his own work in perspective, as part of the whole enterprise with which it is associated.

Essentially full text of the talks by Messrs. Sullivan, Muir, and Gear, and a résumé of part of the resulting discussion, follow.

The Organization of Large-Scale Engineering Work

M. R. SULLIVAN

"The road ahead is dim with the dust of battles still unfought but it is brighter than it would have been had our enemies not misjudged us and themselves, for when Hitler put his war on wheels he ran it straight down our alley. When he hitched his chariot to an internal combustion engine he opened up a new battle front—a front we know well."

These are the words of General Somervell, head of the Service of Supply of the United States Army. Mass production of machines on wheels and machines that fly and the stuff that goes in them—that, he says, "is right down our alley." We can beat the enemy at that.

What that statement means to me is that "the organization of large-scale engineering work" is America's choice of a battle front. On that ground we are called to meet our enemies, and it is fortunate that this is true, for the freedom of the world depends on our acceptance of this front and our success on it.

The thing that distinguishes America on this front is its capacity for organization. The capacity to produce is not entirely a matter of raw materials and skilled labor. Other nations have as much or more of these than we have. Our ability to roll out the machines and munitions lies in soundly engineered well-trained organizations. It is a matter of organization—organization throughout, far-reaching and effective.

In more normal times, a discussion of the organization of large-scale engineering work would warrant, I think, initially defining the type and character of the particular engineering enterprise. In form and structure of organization and the procedures for its functioning, the controlling factor is the work to be done. Since the work to be done will vary greatly in different types of enterprises, the specific form and structure of the organizations would necessarily vary correspondingly. There are, however, many general functions common to all engineering enterprises. These include:

Determination of the basic requirements in accordance with the best known standards

Preparation of specifications for technical apparatus and equipment

Selection of the best route or location for the installation

Obtaining and processing of the raw materials

Employment and training of suitable construction crews

Laying out of proper schedules for delivery of all materials to make for the most efficient and expeditious construction

Preparation of proper operating procedures based on the engineering requirements

Arrangements for putting the project into service to obtain the maximum advantage of the new installation but with the minimum disruption to existing installations

Following up the completed installation to ensure that it functions in accordance with its intended engineering design and to correct any defects in design or construction which may develop under actual operation.

What are the underlying principles of organization, recognition of which has given this nation its power and its know how? Organization is designed to bring all available knowledge and all available energy to bear upon the specific problem at the time most needed. It presents first a problem in specialization, or division of labor, and then a problem in co-ordination of all the specialties and parts of the organization so that it will function as a single, unified, and cohesive team.

Long ago Adam Smith, pointing out the great economies which are the result of specialization of labor in the production of goods and services, wrote: "The greatest improvement in the productive powers of labor, and the greater part of the skill, dexterity, and judgment with which it is anywhere directed, or applied, seem to have been the effects of the division of labor." In principle his statement is as true today as when it was written a century and a half or so ago. In practice specialization has been carried to an extent undreamed of then. And the more you divide the work in order to specialize on the particular parts, the more you have to co-ordinate in order to bring all the parts together in a whole. As the degree of specialization increases to improve the productive power of labor, and the necessary co-ordination follows, obviously the greater the supervision necessary—in other words, the more the whole enterprise depends on sound and able organization. There has been so much discussion of the wonderful results of science that I think the public has lost sight of the fact that science by itself does not produce the goods and services that benefit the public—that until a competent organization takes the results of scientific research and translates them with precision and economy into products and services, the public gets little good from the research.

Industrial organization for large-scale production is particularly American. Relatively to other countries, we have advanced more in organization than in science. That is why making airplanes and tanks is down our alley, even though we had made fewer airplanes than others and no tanks. And the capacity for organization functions in the building of ships, guns, radars, and all the other engines and gadgets of war.

In large-scale enterprise, consideration of divisions of labor and functions should embrace:

Separation by broad categories, such as research engineering, manufacturing, and operations.

Specialization within each category, in order that the work assigned to each individual in each part of the organization may bring to bear, recognizing the limiting capacity of the individual, the maximum dexterity, efficiency, and knowledge in handling the assigned work.

Recognition of the distinction between the respective functions of line and staff work. The line work, which has to do with the actual on-the-job operations inherent in the work to be done, must be supported by staff work responsible for methods, procedures, and general direction of the work.

Decentralization of the work, taking into account geographical factors, to the end that the work will be performed where it can be handled most economically and effectively.

Recognition of the proper relationship of supervisory people to the total force. The importance of an adequately trained and numerically sufficient supervisory force, commonly referred to as "overhead," is worthy of emphasis. Overhead is essential, because without it the result would be an untrained, undisciplined, and undirected force. The exact relationship which will produce the most effective results is dependent upon the type and amount of work to be done, but even in the simplest operation some overhead is necessary. It is an established military fact, for example, that an adequately supervised army is more effective than many times its number of unorganized, untrained people. Hence, separate branches of the army are organized into squads, then grouped into platoons, and so on, until arriving finally at the collection of army corps constituting the entire army. Each unit is given suitable leadership—corporals, sergeants, lieutenants, on up to the commanding general. Any other organization must follow much the same pattern.

Flowing directly from the division of labor comes the second problem of organization namely, the co-ordination between all units. Co-ordination involves:

A common objective mutually understood and subscribed to by all in the organization.

Cohesive direction accomplished by having definite lines of responsibility spreading out from the executive head of the enterprise so that each individual in the organization knows what his definite responsibilities are and to whom to turn for decisions and assistance.

Understanding on the part of each unit of the functions and responsibilities of every other unit. Such mutual understanding is essential for smooth co-operative working.

A sympathetic understanding by the personnel as a whole of the ideals and traditions of the enterprise and of the general reasons for approved procedures.

The aim of co-ordination is that the organization as a whole shall function as a single team; no organization can be successful unless this result is effectively achieved. This co-ordination, to be fully effective, must represent all work done by the various branches and individuals of the organization, with each usually doing a clearly defined and component part of the whole, but all subordinating individual prominence to the efficiency of the whole. I am but quoting the definition of teamwork. It is an intangible quality of organization—one that cannot be shown on charts; nor can any very precise formula for attaining it be stated. Above all, it should embody a spirit of service, the significance of which lies in its instilling not only an appreciation of the importance of the individual's contribution—no matter how humble the assignment—to the success of the enterprise, but also a realization of the deeper meanings and values of the individual's way of life, to be achieved through his part in the skillful execution of soundly conceived and well-organized plans.

BELL SYSTEM ORGANIZATION

Many teams are working together in this country to meet the challenge for maximum production under the impact of war. The Bell System is one such team.

Since the Bell System companies are responsible for rendering a large part of the telephone service to the United States they necessarily constitute together a large and geographically extensive organization. There are about 400,000 employees, inclusive of about 10,000 engineers and scientists located throughout the continental United States. The nature of the enterprise embraces a very broad scope of activities related to electrical communication. These activities run all the way from the elements that enter into an electrical communication system, including raw materials and ideas, through the gamut of research, development and design of apparatus and equipment, manufacture, fundamental engineering plans for future development, design and construction of operating plant, technical problems of maintenance and operation, and studies of technical quality of service—the final product of the organization. An important requirement is to insure that no new device or equipment is introduced into general public usage until it has been subjected to such engineering and laboratory tests that any question as to its adaptability is resolved beyond a question of doubt. Thus it is never necessary to put into public usage untried and unproved devices, which, if not suitable, could have, because of the highly co-ordinated nature of the telephone plant, seriously adverse effects.

By broad categories the work is divided as follows:

Research and development are concentrated in one large organization (Bell Telephone Laboratories, Inc.) which carries out fundamental studies in the branches of science underlying the industry, studies new ideas that relate to telephone equipment and materials, and constantly develops new or improved apparatus and materials for use in realizing the objectives of the enterprise.

The Bell System source of supply (The Western Electric Company) is responsible for providing apparatus and materials as required, manufacturing them in accordance with Bell Laboratories specifications or arranging for their manufacture by others, making complete installations of telephone central offices or other equipment, repairing recovered apparatus, and salvaging useful materials from discontinued plant.

A centralized general staff is maintained by the American Telephone and Telegraph Company to carry out staff work of such a general nature that it is applicable to all the operating companies in various parts of the country and therefore can be done once for all. This staff work includes the investigation of new ideas, the study of service requirements, determination of field of application and programs for the introduction of new types of telephone equipment and materials, preparation of general technical information, including that required for the design, construction, maintenance, and operation of the plant.

There is a series of 19 autonomous operating companies, known as Associated Companies, each with its engineering and other operating departments, and each responsible for telephone operations in a particular part of the United States. In addition, the long lines department of the American Telephone and Telegraph Company provides long-distance service to tie together the long-distance facilities of the System. Individual operating companies are subdivided geographically into divisions and districts in accordance with their operating requirements. The engineering work is in part concentrated in the headquarters of the companies and in part distributed geographically by divisions and districts according to its nature.

Further specialization is attained within each of the broad categories:

Each company is departmentalized and the work divided within each department to meet its specialized

requirements. Highly functionalized staffs are necessary and provided for. This is particularly true within the engineering and research departments, which are organized and equipped to go deep into the heart of all communication techniques.

All of the work, whether line or staff, engineering, research, or operations, is under the direction of competent supervision of varying grades. On the average one out of each eight employees is a supervisory employee.

An unusually high degree of co-ordination is required. In handling even the simplest telephone call, for example, the procedures at the orginating and terminating points, as well as in all the intermediate links, must be carried out in co-ordinated precision. The Bell System has been described as a team of 400,000 persons; an organization where the 400,000 can play their positions, knowing all the plays and all the signals, and knowing that what this team does is absolutely vital, for over its wires go many of the signals for all the other teams that are getting things done. To explore the conditions and to depict at any length the practices that have brought about this co-ordination and teamwork would require more space than can be devoted to the subject here. Suffice it to say that the high degree of co-ordination of the organization reflects in a great measure the ideals and traditions with which the service is endowed and the common bond between people who know the real significance of working together to serve an outstanding common purpose.

The organization features described for the Bell System are but typical of those of many other large enterprises. And of course the Bell System is only one organization, collaborating with many others, to effect maximum production for the war effort, in which effort the engineering departments have a unique responsibility. Engineering, embracing as it does the origin, cultivation, and integration of powerful forces, has a major role in the full, complete, and far-reaching organization of America's productive forces for total war.

The military objective is not new. On the contrary, history records that engineers were first military men. In English history, for example, the word "engineering" was originally applied to "the operations of those who construct engines of war and execute works intended to serve military purposes." Now again, engineering must concentrate on military rather than civil objectives. The responsibility is grave, since the military outcome holds in its crucible the destiny of mankind. But with confidence born in the knowledge of the integrity, wisdom, and ableness of our organization leadership we may have faith that our capacity to produce will be organized with maximum effectiveness in this our most troubled hour. Looking beyond that, our work and spirit of today nourishes the aspiration of tomorrow—for a new world, unhampered by oppression and tyranny—a world in which the full power of organization will be utilized to produce a civilization dedicated to the well-being of mankind and bringing benefits to the individual which the boldest of men cannot now visualize.

The Engineering Organization of a Large Industrial Business

R. C. MUIR

The General Electric Company, with which I have been associated for 37 years, embraces more than 50 lines of products, which vary greatly as to type—for example, measurement instruments and steam turbines. The policy of the company, favored by the newness of the art, has been such that no product has been frozen for any great length of time, and there has been a constant flow of new or improved products to meet the ever-expanding uses of electricity.

With this background it is apparent that the engineering branch must be supported by a strong research organization, a strong sales and sales-engineering organization, and a versatile and able manufacturing organization.

Several forms of engineering organization could be designed to take care of an operation such as this; but before putting any one of them in a one-line diagram it might be well to set down a few principles which seem quite fundamental in the organization and management of the engineering activities of a large industrial organization. The problem is one of obtaining directness of action and at the same time freedom of action, without conflict.

UNDERLYING PRINCIPLES

We may view the form of organization as a mechanism or structure through which management functions; and, as with a well-designed machine, it must be simple if it is to be efficient and direct in action. It should clear the path of obstacles, allowing to the individual engineer freedom to do, rather than specifying what he cannot do.

We are in a business; and the engineering organization, being a part of that business, cannot be considered by itself; it must be designed into the fabric of the whole organization. Engineering should be tied into almost every phase of the management of the business, from the top engineering executive to the engineer in charge of any one line of products.

The form of organization at its best should be subordinate to personnel. The organization should be shaped to meet the particular qualifications of the men, rather than the men to meet a specific or exact form of organization. This is the principal difference between industrial and military organizations. E. W. Rice, Jr., former AIEE president, once said that the most perfect form of organization in the world would fail unless it was supported by an adequate personnel, but that a very good job could be done with the right people even though the form of organization was quite inefficient.

The central staff should be small and compact, and in so far as possible it should confine itself to the broad direction of the work. The individual engineers who head the various departments should be built up by placing upon them complete responsibility for the engineering of the line of products to which they are assigned. Responsibility should always carry authority. No one in the engineering organization should be more than one or two men removed from the central head of the organization, whose door should always be open to any engineering employee.

The service of consultants, experts, and freelances should be available to those carrying the responsibility for the product, but these specialists should not be in authority. It is preferable to locate them in the laboratory or laboratories, where they can serve the entire engineering organization, rather than to duplicate these talents and facilities in each engineering department that is responsible for a specific product.

The over-all engineering department should be supported generously by engineering committees on materials, practices, applications, or technical problems common to a number of the product engineering departments. Engineering conferences are helpful.

It is most satisfactory if you can develop your own men, choose a wide variety of talents from a wide variety of schools, plan the development of your men 15 years or more ahead, keep the age line healthy—that is, always have new talent coming along and plenty of reserve. Always have a runner-up for every important position so that embarrassment cannot result from the loss of any one man. Constant vigilance should be exercised to see that no one is kept too long in a position that does not tax his ability. Educational courses are tremendously important. Loyalty, spirit, and morale cannot be legislated; these qualities must be cultivated and developed, and above all, exemplified.

ORGANIZATIONAL PATTERN

In regard to the form of organization itself, there should be an engineer executive in charge of design or product engineering. His staff should include members who concern themselves with operations, budget making, expense control, and other administrative matters; members who know the products and who concern themselves with quality control, the research and development program, and the personnel and the personnel requirements; and members who obtain and train the personnel for all the departments. It is preferable to have a number of the staff members broadly trained so that they know something of the business, the development program, and the personnel. These staff members can carry on with less dependence upon the executive in charge and at the same time be making larger jobs for themselves.

The commercial-engineering organization and the research organization could also report to this engineer executive, but in an organization as large as the one under consideration it has been found desirable to have an engineer executive in charge of the commercial-engineering organization (which includes the field organization) and another executive engineer or scientist in charge of research. These latter two report directly to the president of the company but are closely co-ordinated with the design-engineering organization.

The executive in charge of engineering is a member of the president's advisory committee or the committee on general operations; thus providing at the top a connection for engineering with the business and policy points of view. He, his staff, the Research Laboratory, the commercial-engineering department, and consultants are functional, operating, as it were, across the entire organization.

The executive in charge of engineering who has a good staff has little occasion to worry about day-to-day operations, because the organization carries these out very well. He should keep well informed, however, on the operations in all departments. This he can do through short quarterly reports backed by frequent contacts with his staff members. Only in this way can he give broad supervision to the work and make wise decisions in those matters which come to his attention every day. This familiarity also permits him to show an interest in the work of any department, which has a marked influence in improving spirit and morale.

If the specification of a strong central engineering staff is met, the executive in charge and his staff are looked to as one by most of the organization. The staff carries the management load, largely, leaving the executive in charge sufficient time for the consideration of major projects, changes, or matters which only the executive can handle.

Since the products vary greatly, it would seem that each product might support its own design-engineering organization. In some of the more comprehensive lines, such as motors, transformers, switchgear, or turbines, where types or sizes make natural division points, two or more engineering departments are preferable to one.

Each design-engineering department is headed by an engineer who functions in management through a committee of three—one representing manufacturing, one representing sales, and one representing engineering. These three are responsible for the business in that line, under the broad supervision of executives higher up. The engineer also has representation on the product committee, which plans the product for the future, and on those co-ordinating committees which have to do with such general problems as heat transfer, lubrication and bearings, insulation, and so on, that are of interest to him. He is responsible for the design, development, and production engineering, and must have an organization commensurate with the job.

Each of the more than 50 engineering departments varies somewhat in the form of organization, because of variations in product and in the men who make up the department. The engineer does not attempt to carry on his payroll highly specialized men whose full-time service he does not require; these are carried by the laboratories or the central staff. On all technical matters he reports directly to the engineer executive in charge (or his central staff), but this is not practical in the case of administrative and production matters in a wide-flung organization that has many plants in different parts of the country.

Policies covering manufacturing and engineering personnel housed under the same roof must be harmonized; and this duty, and the operation of the plant at large, is performed by a works or plant manager, who also carries the intermediate responsibility for engineering operations in his plant. The latter is a full-time job for a high-grade man, so the plant manager is supported by an assistant who assumes this responsibility.

Each plant also should have a laboratory for material testing, process control, and such other work as may be carried on better by a laboratory than by a manufacturing or engineering department. Specialized laboratories, such as those dealing with plastics, high voltage, should be maintained by those departments that can justify them. A research laboratory should serve the entire group of laboratories and engineering departments.

The functioning of the engineering organization, then, is directly from the office of the executive in charge of engineering to the various engineering-department heads on technical matters, and through the works manager to the various engineering-department heads on administration and production matters.

Except in very special cases, the executive in charge of engineering is not brought into the matter of engineering of orders for production. This is handled directly by the individual engineering-department head. He co-operates with the factory in planning the manufacture and scheduling production, and follows his designs through the factory until the completion of manufacture and test. He is responsible for the suitability of the product and has the authority to pass it, or to hold it until he is satisfied that it meets the requirements. It is his responsibility to obtain such outside assistance from consultants or laboratories as he may require. The executive in charge of engineering always has the opportunity to review the designs or engineering on any specific order and to hold engineering conferences on such orders when they are sufficiently new or outstanding to warrant it, or when they depart radically from former practices.

Therefore production engineering of any product is direct, and there is no pyramiding of approvals or responsibilities. But there must be a constant check from the head office and from the works manager on the meeting of schedules and on the quality and the cost of the product.

Each engineering department carries on a very active development program in which the engineer is guided through his product committee and the commercial-engineering group. A budget of projects to be taken up, with periodical reports as to progress, is always valuable; and frequent check on them by the central office is helpful and stimulating. It is in development work that engineering conferences and co-ordinating engineering committees are particularly valuable. We find that even though business in a particular line of products is extensive and the engineering department is capable and well supported by its own testing and developmental facilities, talent from outside that department is helpful.

A reasonable proportion of the personnel of each engineering department should be men primarily interested in the development or research, as it is only with those who have such abilities that development work can be carried out successfully. The inherent ingenuity and the natural unrest of persons of this type assure a forward-looking development program.

However, in addition to the development work carried on in the established departments, the General Electric Company finds it well to encourage research and development in its Research Laboratory and other laboratories, as well as by consultants and freelances, quite independently of any specific objectives set up by the design-engineering departments.

It has been the policy of the company to recruit technical students from graduating classes and to train them for the various positions in the engineering department, the commercial department, and the manufacturing department. Inbreeding is automatically avoided by the practice of recruiting from a wide number of schools, by deliberately choosing different types of talent, and by means of a test training course which requires the student engineer to obtain experience in several testing departments or laboratories before he is assigned to a specific engineering department. About 10 to 15 per cent of the newly graduated engineers entering the service of the company have the opportunity of participating in a three-year course in advanced engineering, during which period they have assignments in several different departments.

These provisions, in addition to a generous policy of participation in sponsor and trade-society activities, and the numerous customer contacts made in the normal course of business, all tend to prevent narrowness and to train men who know the organization and know how to work collectively in it. They also develop in the men a spirit of loyalty and co-operation that goes a long way toward making management's job easier.

The development of personnel comes closer to the central office than any other operating function, and this is as it should be. For this reason, it is well for the executive engineering head and all the other members of his staff, aside from those who give their entire time to engineering personnel, to be thoroughly interested in and collectively acquainted with those in the various engineering departments. In this way not only can the various departments be manned with adequate talent, but the men can be moved around and given broad development for positions more important than those for which they would otherwise be qualified.

There may be many variations in the organization setup or in the method of functioning just described, but the principles underlying the form of organization and its functioning remain substantially unchanged. As a matter of fact, as the business of the General Electric Company has expanded both as to variety and volume

of products, we have found it advisable to make modifications in our form of organization from time to time. Such changes have seemed desirable from the business point of view rather than from the engineering viewpoint.

At present there are four main departments of the company. The largest, which covers apparatus lines in general, is in itself organized and operated very much as described above, the engineer in charge being an executive officer of the company. The managers of the other departments are executive officers of the company. These departments do not have an executive officer in charge of engineering, but this may come about should they grow in size or complexity.

The president of the company has on his staff an executive officer of the company who has the responsibility of co-ordinating and supervising broadly the engineering of all of the departments of the company. He also is responsible for the co-ordination of research and engineering. Hence, the over-all operation or effect is as described.

I should like to suggest a concept of an ideal engineering organization in operation. Imagine the form of organization to be an edifice or workshop, a structure of offices or functions where men do useful things; a structure stable as to framework but flexible as to partitions. Then picture the living or mobile part of the organization, a continuing, never-ending flow of men through this structure, who work as they go and progress according to their contributions. Each year an army of new men who have diverse possibilities enter the structure, opportunity awaiting them, ambition and ability advancing them. As these new men enter, older men, who started some 40 years earlier, leave the structure—make their exit from those final offices to which their contributions have carried them.

All through the structure there is a moving up or rearrangement of men, often accompanied by the moving of a strut or a partition to give the new incumbent more freedom. Sometimes new partitions or rooms are added to take care of expansions or new work. The decisions as to which men shall move and to which offices they shall move are made by the men at the top of the structure, assisted by the men in the various pinnacles, all of whom have been encouraging, guiding, and directing the men who are now ready to move up to higher positions.

The men in these top positions also will move on when their time comes; and one measure of their success is how wisely they have chosen and how well they have trained those who are to succeed them.

The output or contribution of the collective group is governed by many factors—the ability of the men, their supervision or direction, the structure in which they work. These factors might be likened to the carbohydrates, proteins, and fats in our diet. Fully as essential, however, are those intangible factors—loyalty, morale, co-operative spirit, pride of heritage, an intense desire to serve mankind well—which might be likened to the hidden vitamins in our food, without which we languish and fall the victims of disease. These intangible factors are developed by the opportunities and the traditions of the engineering profession and of the company of which the engineers are a part.

Engineering as an Implement of Managenent

H. B. GEAR

From the dawn of recorded history, the engineer has designed structures and devised procedures for their erection; for the glory of a king, as in building the pyramids; for the welfare of a people, as in the construction of great stone aqueducts; in creative steam engines that eased the drudgery and speeded the output of workmen; and in recent generations in developing the marvelous uses of electricity in applications to light and power, to communication, and to radiobroadcasting.

The aqueduct was no doubt the result of the application of the discovery of the use of stones in the form of an arch. This detail of construction, impelled by an aggressive Roman civilization, became the basis of great public works beneficial to many.

The story of Watt and the tea kettle may be ficticious but it illustrates again how a principle first observed in a very small way can become, at the hands of an engineer, a mighty force in the advancement of civilization.

The discovery of the relations between the electric current and magnetic force remained for some years only a laboratory experiment. In the hands of engineers it became the foundation of electricity supply systems. Such inventors as Brush, Thomson, Edison, and others made electric lighting and power applications practical for general use. In later decades these advantages became available to all classes of people.

In like manner, the early telephone of Bell was looked upon as an interesting toy. It was exhibited first at the 1876 Centennial Exposition. The value of the telephone was not fully realized until about two decades had elapsed. As a young man when I came to work for a utility company in Chicago, and had an engineering degree from Cornell University, I had never talked over a telephone. There were none on the campus at Cornell University, and none in the town I came from in Ohio excepting between the fire station and the downtown stores. The telephone did not become an instrument of the people until 1896 and 1897; when the ten-party line was introduced and the telephone was made available at $1.50 a month. But Edison and Bell saw a future for their inventions and because of the breadth of their vision and the courage of their convictions, they brought the world to their feet in admiration and respect.

The work of early radio engineers was catapulted to the state of an industry by the forces of a world war. There the vacuum tube made possible communication between different arms of the military and naval forces, in ways previously unknown and of untold value. The developments of the war period led to the introduction of public broadcasting and the foundation of a new industry. This industry, to an even greater extent than the light and power and the telephone industries, was brought to an early state of maturity by a host of competent engineers whose contributions are too many to be enumerated here.

In the 1890's it was often said that electricity was in its infancy, and looking back upon the growth its use has made in 50 years, the truth of that statement is readily apparent. In those days generators were called dynamos and they were driven by steam engines through shafting and flapping belts. The common sizes were rated at 50 to 100 kw. Lighting of stores, factories, and outdoor spaces was done by arc lamps supplied from series circuits. Each circuit was supplied by its own dynamo and each lamp absorbed 50 volts at ten amperes. Dynamos were designed to carry 100 lamps at 5,000 volts, but one company made 150-light machines at 7,500 volts.

In larger cities arc lighting stations were readily distinguished by the large number of overhead wires leaving the station. Incandescent lighting was served from Edison three-wire d-c systems at 115/230 volts in the central parts of large cities, and from a-c systems in outlying parts.

In Chicago the outlying sections were separate municipalities. After six of these suburban municipalities had been annexed in 1890, there were some ten electric companies supplying service in the city. Six of them were giving incandescent service and four were selling only arc lighting. Four companies sold incandescent service from a-c circuits and two from d-c Edison systems. Of the four companies selling a-c service there were no two that used the same system. Three companies used 1,100 volts and one had 2,200-volt single-phase circuits. Frequencies were 60, 125, and 133 cycles per second. Two of the companies had two-phase generators supplying single-phase lighting circuits and a few two-phase elevators in hotels. Power service was given by two companies serving industrial areas from 550 volt d-c circuits. Secondary voltages were 55 or 110. Where 55 volts was used it was necessary to place a separate transformer for each building. This required from four to five times as much distribution-transformer capacity as is needed in modern systems.

Early in the 1890's it became apparent to manufacturers and to utility operators that the results of the active competition that had existed in the previous decade had been of doubtful benefit to the user of service, the manufacturer, or the utility investor.

Duplication of plant and multiplicity of systems had nullified the possibility of attaining the benefits which later were found to accrue to producer and user alike as the sale of electricity became more general. By sheer necessity there ensued a period of consolidation out of which there came the adoption of standards of frequency, voltage, and systems of distribution.

At the convention of the National Electric Light Association held in Chicago in 1898, the program was devoted to papers

and discussions dealing with technical and operating problems. The comparative economy of different methods, the use of a demand system of charging instead of a simple rate per kilowatt-hour, and the merits of d-c versus a-c systems of distribution in large cities were discussed. Matters of sales policy, management, personnel, or finance were considered matters to be discussed only in private with acquaintances in other companies. These matters were of minor importance as compared with the operating troubles that had kept engineering practices in a continuous state of flux.

When some degree of standardization became possible, at the turn of the 20th century, several of the larger utilities adopted for city distribution the four-wire three-phase system operating at 2,300/4,000 volts. With this settled, it remained to replace the inefficient tangle of competing systems that existed in certain parts of Chicago with a type of distribution capable of development as the load required, and with more efficient generating stations. The job involved removal of old equipment operating at odd frequencies, and at voltages too low for the distances to be covered. Distribution transformers were replaced by newer designs of much better efficiency and more dependable insulation. The economics of secondary distribution were determined and proper sizes and transformer spacings selected.

Single-phase 2,300-volt feeders were arranged in such manner that when a demand for power was developed two additional wires could be added to give three-phase supply.

Thus a flexible system with well-regulated voltage was made ready for the rapid expansion of use that was to follow. To the young man who was thrust into that confusion of systems and was privileged to bring order out of chaos, it seemed inherent in the nature of a light and power system that it should present interesting problems for the special benefit of young engineers. A decade later it began to dawn upon him that an electric system was created as a business enterprise, not merely to provide interesting problems for young engineers. He was to learn in subsequent years that he and his associates in the work had in fact been using their engineering as the implement of a management confronted with many harassing problems of operation.

When engineering practices became more standardized, types of construction used became more nearly uniform, and the work of extending and operating the plant became more nearly routine, then operating troubles were less frequent and reliability of service increased. The result was a steadily declining trend of cost of supply and of rates of charge which in turn brought greater public acceptance of electric service and many new applications of its use.

The energies of management were thus freed for development of the enterprise, for increasing the efficiency of production and distribution, and for extending electric service into new fields of usefulness. These benefits to management accrued as well to investors who in early years had risked their funds in a new and hazardous enterprise, had seen their investment rapidly depreciated by obsolescence and their dividends withheld by the necessity of using earnings for making plant extensions which could not be otherwise financed. The final result was that the use of electricity in the home passed from the status of a luxury enjoyed by the well-to-do to that of a vital necessity enjoyed by millions of residents of cities, villages, and farms.

This bit of history is one example of achievement that had its foundation in engineering and invention. The cathedrals of other centuries have a counterpart in the massive power houses of our century. Indeed their high-vaulted turbine rooms have suggested to some the designation "cathedrals of power."

The story of the development of electricity supply has its parallels in the growth of transportation, communication, and manufacturing. In each of these fields the engineer has been the implement of growth and the reinforcement of the energies of the leadership in their onward march.

In these days of expanding activities, the picture of engineering achievement is better suggested by the image of many structures making up a great city, than by that of a cathedral. There are many buildings of many kinds, each useful in its own way. The young engineer, and sometimes the engineer who is not so young, needs at intervals to leave the particular place of his daily work to see and talk with others. Occasionally he needs to take time out to rise above the scene where he may see the whole city and be aware of his place in it.

The value of engineering as an implement of management is summed up in three elements:

(*a*) Knowledge of intricate details coupled with the intelligence to apply them to the solution of engineering problems that present themselves

(*b*) Ability to co-ordinate his own specialized knowledge and experience with the knowledge of those working in other fields, thus bringing every available resource to bear on the problem at hand

(*c*) Ability to co-operate with the whole team in bringing projects to a successful completion.

When engineering is thus used as the effective implement of management, it becomes likewise the implement of human achievement.

Discussion

Opening discussion on the three addresses President Prince suggested that "engineering is making a fundamental change in all our ideas of government and social structure generally. The weight of that may perhaps be brought home to you when you realize that the 12 good men and true who constitute a jury are the court of last resort in the determination of a fact. You can see they might have been able to do a job at the time the Government was setting up a program. At the present time, if you pick up 12 good men and true from the street corner and ask them to pass on any such subject as the regulation required in a transmission line, or any one of the many technical subjects with which you are familiar, you will see that we have outgrown the whole structure.

"In a sense, our various industrial organizations are experimental laboratories in which we are trying to find out some method of handling our society so it can operate in the world we have built up. If we can find some way to handle all of these forces that we have learned to handle in a technical way, or association way, which means organization, then we will have made it possible to go into a new world on a small scale. Of course experiments are being made by all of the organizations in the United States, experimental approaches to just that sort of problem."

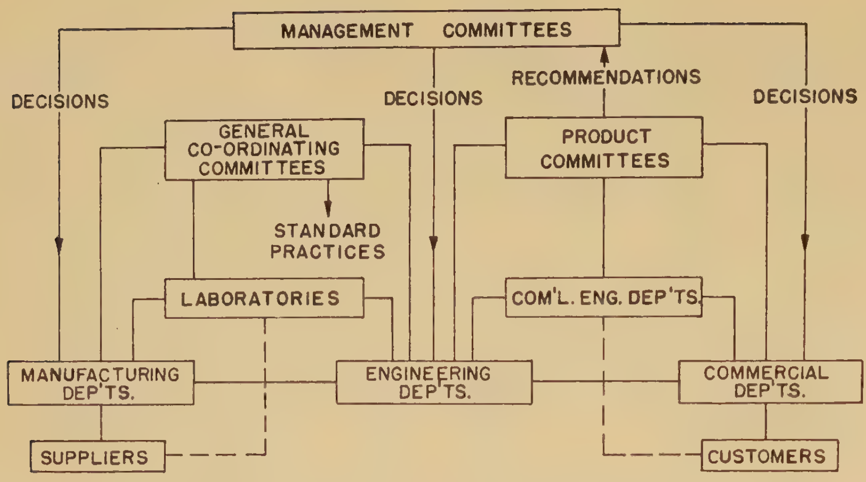
W. F. Simms, Commonwealth Edison Company, commenting on Mr. Gear's talk, pointed out that "in the earlier days of utility systems the head of the engineering department was comparable to a company commander in the Army operating under conditions where the field of operations was very largely under his direct observation, whereas today he is in the position of a general commanding a much larger body of troops on a very much more extended battle front and his information must come from the unit commanders in the field. The engineering department head is, also, very largely dependent for his information upon the reports of his assistants in charge of the various phases of the work. Under these conditions, administration and co-ordination of effort become a very much more important part of his work and the working out of engineering details becomes more and more the responsibility of his various assistants. This leads to the conclusion that those of us who are engaged in the direction of the engineering work of large utility organizations could very well reverse the title of Mr. Gear's talk and give consideration to 'management as an implement of engineering.' "

GENERAL-ELECTRIC ORGANIZATION CHART

P. L. Alger, General Electric Company, Schenectady, N. Y., presenting the accompanying diagram of General Electric organization, said, in part, "Electric power is unique in the diversity of its application, and also in the interconnections it creates between widely separated devices. The electrical industry, therefore, deals with controls, or nerve systems, if you please, that tie together a great variety of machines, both mechanical and electric, causing them to function as elements of a single system.

"Thus, the various departments of an electrical manufacturer cannot be set up independently, with only executive relationships, as is done in many other industries. The engineering of each separate department must be closely co-ordinated with that of other departments.

"The diagram of General Electric's organization is by no means exact, nor is it permanent. On the contrary, it is an idealized picture of an ever-changing situation. It may best be understood by an analogy with the familiar form of our national government, with its distinct executive, legislative, and judicial functions. Montesquieu, in his 'Spirit of Laws' wrote



Technical organization of the General Electric Company

in 1750 that the separation of these three functions is essential to freedom, as borne out by the long history of England. The Founding Fathers accepted this principle as basic, and designed our constitution around it. I am profoundly convinced that this principle is sound, and that no large organization of human beings can long endure unless the executive, legislative, and judicial powers are well organized and are thoroughly independent of each other. In this diagram of the General Electric technical organization, the principle is adhered to by providing:

"1. An executive head of each department, who is solely responsible for all decisions made and results obtained in his sphere of action. The respective heads of the commercial, engineering, and manufacturing departments for any one product form a management committee of three, this management committee having over-all responsibility.

"2. A product committee, or, if you please, a legislature, for each line of apparatus, including representatives of engineering, commercial, and commercial engineering departments. The commercial engineering function is essentially that of planning for improvements in the product, and especially for adapting the product to fit better into the complete electromechanical system of which it is a part. Usually the commercial engineering representative is chairman of the product committee. The product committee writes specifications, sponsors development programs, and proposes new undertakings. Its conclusions are submitted to the several management committees concerned, in the form of recommendations only, which the management committees may accept, defer, or reject, as they see fit. The Product Committee has no executive function whatever, and cannot override a Management Committee veto.

"3. A general co-ordinating Committee for each material, process, design feature, or other important subject, that is of importance to several different departments. The members of these committees are scientists, experts, and specialists of all sorts, who know the last word on any technical question. The co-ordinating committees, therefore, form the courts of highest authority on all technical matters. They exercise the judicial functions of interpreting the laws of nature, and saying what can and what cannot be done without incurring nature's unfailing punishment of transgressors of natural laws. The co-ordinating committees have no power whatever to enforce their decrees, however. The executive head of any department can go right ahead contrary to their dicta, if he so desires. If he is right, the committee will become better educated, or will be revised. If the committee is right, the executive officers of the company may take corrective action against the erring department head.

"The membership of the product and co-ordinating committees is not clearly defined, but is continually changing, in accord with the principles of flexibility and flow of personnel Mr. Muir has expressed. Most of them grow up naturally to fill a need, and only gain formal recognition after they have proven their value by results attained.

"There are two outstanding advantages of this form of organization: In the first place, it encourages creative developmental work or research by individual departments where the experts concerned deal directly with the factory and practical men. This is possible because such experts have contacts with other departments, which keep them stimulated and provide them with suggestions. Also, they can render reciprocal services to other departments, enhancing their opportunities and rewards far beyond what they could expect if confined to a single department. The ideal sought is for every engineer to do some research, and for every scientist to be in some degree an engineer.

"In the second place, this plan permits unlimited extension to additional departments, or associated companies. By separate organization of the research and developmental activities, the planning activities, and the business responsibilities, it becomes possible to plan co-operative research and make plans quite independently of economic conditions. As time goes on, we must expect greater government participation in planning, and a greater sharing of the fruits of research with all who may make use of them. Thus, this plan of organization may prove useful in the development of that after-the-war era of co-operation to which we are all looking forward."

GETTING IDEAS FROM RANK-AND-FILE EMPLOYEES

In response to a question from President Prince on methods of getting ideas up through, as well as down through, an organization, Mr. Sullivan said that in the Bell System this was done "by frequent meetings with the employees and by first giving them as much information as possible on all the reasons for all procedures." "We want our people to be reasonable in their dealings with each other and with the public," he said, "and in order to be reasonable, they must know the reasons." He mentioned that in some of the System's companies progress is being made along lines advocated by War Production Board Director Donald Nelson and others to get the advantage of group meetings on particular problems. "That requires extensive conferences at all levels of supervision," he said.

VERTICAL VERSUS HORIZONTAL ORGANIZATIONS

In a discussion on the relative merits of vertical and horizontal types of organization in engineering operations, Mr. Muir expressed the belief that the form of organization is less important than the abilities of the personnel, the freedom they are given, and the co-ordination existing between departments. Mr. Gear cited the experience of Commonwealth Edison Company to show that a form of organization which was effective at one time might be outmoded by developments in the company or the industry, and a change in the alignment of functions might be necessary to meet existing conditions.

APPLICATIONS TO SMALL INDUSTRIES

A request from the chair for questions from the point of view of the small company produced two queries, one on operation as distinct from production, and one on personnel. The question, "just how would management go about to produce an operating engineering department?" was answered both by Mr. Sullivan and Mr. Muir. The former explained that in the telephone industry, "operations" are considered as comprising plant maintenance, commercial operations, and actual handling of equipment, or traffic. Co-ordination of these with the engineering department by having the heads of departments in close touch assures that operations are carried out in accordance with engineering design, he said. Mr. Muir stated that in the General Electric Company, responsibility for plant operation—continuity of service, supply of electricity, and so on—is centralized with the plant engineer, with the plant manager at hand only to approve the plant engineer's recommendations or specifications for appropriate action. In designing new equipment, the plant engineer has the assistance of the construction engineering department. The operation of the plant is thus organized in much the same way as is a design engineering department, he said.

On the subject of personnel, another questioner commented that in the United States people are prone to think "the organization is made for man and not man for the organization," and that while in a small company there is no question but that the organization must be fitted to the man, he had been interested in Mr. Muir's policy of doing the same for a large organization, and wondered how far this could go. Mr. Muir declared that, in agreement with similar statements from Mr. Sullivan, he considered personnel fundamental. "You cannot do anything without men," he said.

"The way to develop men is to give them freedom, latitude; not tie them down; not give a man only one job, or hold him in any job that does not continue to tax his ability. Otherwise, we don't have progress. As I have said before, if we don't have progress, or develop men, we have no longer an engineering profession; we have a craft.

"Since we are developing our own people, we never consider an engineer as a job but as a man. The particular job is whatever he makes it. We don't tie him down. It is quite probable that the head of a large department will not have the same qualifications as the man preceding him; he may be a better designer, or a better administrator, or executive: in which case he shifts the form of the organization. If he is a highly technical man, we support him by a highly capable executive or administrator; if he is a highly capable executive or administrator, we support him by a highly technical man. The job is constantly shifting, so as to give the incumbent all the freedom and latitude possible.

It works very well with us. But just as under a democratic form of government, it is much harder for the citizen than it is in a dictatorship, where he is told exactly what to do, it is much more difficult in our form of organization for a man who is brought in to understand that flexibility than for one who is trained in our departments. The new man has to learn that nothing is personal; everything is for the company's interest."

INDUSTRY VERSUS POSTGRADUATE STUDENTS

Dean A. H. Lovell of the University of Michigan posed a question with reference to the matter of postgraduate college students. Although praising the relations of industry with undergraduate training, he complained of the tendency of industry to allow to many no extra credit or standing for postgraduate work, and asked point-blank whether industry had any intention of broadening this general attitude which he decried.

Mr. Muir challenged Dean Lovell's statement with reference to industrial research, pointing out that industry has definitely recognized the position and contribution of the postgraduate student in the field of research. With reference to engineering, Mr. Muir said: "A man can learn only by doing," and pointed out that so far industry had been "unable to arrange with the schools any advance engineering work that is of any special value to the industry so far as concerns engineering."

DEFINITION OF AN EXECUTIVE

Concluding the discussion, Doctor H. S. Osborne, newly elected AIEE president, quoted a definition of an executive as "a man who makes decisions without having the facts." He went on to say that "in making a decision, of course, anyone desires to have all the facts that are available, and if the organization is a proper one, the facts can be reasonably collected and arranged and analyzed for the purposes of a decision. If when we have enough facts, they are allowed to speak for themselves—as they are if the organization is correct—such a decision should not have to go to the top executive. One of the fundamental characteristics of a good organization is that such decisions do not reach the top executives—at least not in the form of questions. But many questions come up on which it is not possible to get enough facts to let them speak for themselves. Those are the questions that should go to the top executive, and those are the questions that executives like."

Conferences at Summer Convention Relate to War Conditions

Six conferences, on widely varying subjects but all connected in some way with the war effort, were included in the program of the AIEE summer convention, held at Chicago, Ill., June 22–26, 1942. The conference on lighting aids to wartime production is reported elsewhere in these pages. The other conferences dealt with local engineering councils, particularly in relation to war activities and postwar planning; with educational matters under war conditions; with power supply for the war program; with electronic control of resistance welding, and with measurements of surface finish, both the latter being related to processes significant in war production. Brief reports highlighting the proceedings of these four conferences follow.

LOCAL ENGINEERING COUNCILS

Following up the conferences held at the South West District meeting, St. Louis, Mo., October 8–10, 1941, (*EE, Nov. '41, p. 548–9*) and at the AIEE winter convention, New York, N. Y., January 26–30, 1942 (*EE, Mar. '42, p 148–52*), a conference on local engineering councils and their participation in civic affairs, with emphasis on wartime activities and postwar plans, was held at Chicago, June 22, 1942, with T. G. LeClair presiding. Speakers were Frank F. Fowle, head of Frank F. Fowle and Company, Chicago, who described the formation, objectives, and recent work of the Illinois Engineering Council; K. B. McEachron, General Electric Company, Pittsfield, Mass., whose topic was "The Co-ordination of Various Groups of Engineers in Massachusetts During the Preparation of a Licensing Law;" and K. R. Brown, consulting engineer, Des Moines, Iowa, who discussed the methods of co-ordinating the work of the engineering societies in that state. Active discussion followed, in which P. L. Alger, General Electric Company, and others participated.

EDUCATIONAL MATTERS UNDER WAR CONDITIONS

At the conference on educational matters under war conditions held Thursday afternoon, June 25, 1942, under the chairmanship of R. W. Warner, with an attendance of about 30, Professor Warner reread the 1942 winter convention resolution of the committee on education, concerning the matter of adequate continuation of technical education even under war conditions, as a necessary means of producing the engineers required for war effort as well as the engineers required for the after-war period.

Professor Paul C. Cromwell, New York University, presented a report concerning student guidance activities in the various AIEE Sections. This precipitated a long and general discussion of various aspects of the subject of vocational guidance for high-school students. Professor W. M. Young of Ohio University expressed the opinion that in his experience the quality of the home community has much more bearing on the quality of college students received from different high schools, than has the high-school faculty itself. He urged against trying to "wish on to high-school teachers" the job of professional guidance, pointing out that teachers are professional educators. He suggested that local Sections of the Institute and other engineering organizations should be the agencies through which local guidance should be promoted and handled in each locality, with the necessary co-operation of the high-school authorities. R. C. Muir of the General Electric Company challenged Professor Young's opinion, stating his belief that proper guidance of high-school pupils is only an integral part of the properly constituted high-school educational process which should be aimed toward the objective of turning out young people educated for life, rather than young people crammed full of academic knowledge. Mr. Muir defined education as the development of each individual to the limit of his individual ability, and in the direction of his interest.

Extensive discussion also ensued concerning the matter of vocational training, technical high schools, and related variations of these topics. Mr. Muir, P. L. Alger, and other noneducators present pointed out that too many high schools direct their curricula almost entirely toward college-entrance requirements, thus failing properly to orient the very large proportion of high-school students who do not or cannot go on to college. A better orientation of high-school courses toward the needs of average life conditions, supplemented by appropriate use of technical high schools and vocational high schools seem to be considered to represent the desirable trend in high-school educational effort. The New York State situation and experience was described by Mr. Muir; the Schenectady situation in particular also was touched upon by Mr. Muir and Mr. Alger. Mr. Alger called particular attention to C. E. Crofoot's paper on the

Mont Pleasant Technical High School in Schenectady (presented at the North Eastern District meeting, Schenectady, N. Y., April 29–May 1, and scheduled for publication in a future issue of *Electrical Engineering*), and urged all present to give serious consideration to such a high-school procedure in other communities. Some college professors voiced an objection to high schools encroaching upon the range of college technical subjects, but others recognized the necessity for high schools to do a better job of training for life rather than serving just as college preparatory schools. Mr. Alger defined vocational training as a procedure intended to interest boys in *doing* things, not necessarily a training directed toward any specific job or enterprise.

One speaker dwelt at length on the theme that high schools (and many others, including some colleges) have their curricula and procedures arranged to serve the "average student" thus "leaving the student of superior ability as literally the forgotten person." It was the general consensus that efforts should be made so to arrange high-school curricula and procedures as to prevent students of superior ability being hampered in their mental development by being held down to routine schedule; arrangements should be made whereby they can reach ahead and elect advanced work up to the limit of their ability.

POWER SUPPLY FOR WAR NEEDS

The combined session and conference on power generation, held Monday afternoon, June 22, 1942, with W. L. Cisler presiding, included one technical paper, scheduled for publication in the *Transactions*, a conference paper, and two special addresses. The conference paper on "Power Facilities and Problems in South America," by R. P. Crippen is tentatively scheduled for publication in an early issue of *Electrical Engineering*. "Power Supply for the War Program" was the subject of addresses by J. E. Moore and Edward Falck of the War Production Board; arrangements are in progress to secure clearance of these addresses also for future publication in *Electrical Engineering*.

ELECTRONIC CONTROL OF RESISTANCE WELDING

The conference on electronic control of resistance welding was held Wednesday morning, June 24, 1942, with S. B. Ingram, chairman of the joint subcommittee on electronics, presiding. G. W. Garman and E. H. Vedder opened the conference by briefly outlining the two principles, on one or the other of which all present systems of electronic control are based: the a-c control method and the energy storage method. They pointed out the most important features and limitations of these two methods, as well as some of the new trends in their development.

General discussion followed on several subjects, the first of which was the desirability of a simple, practical, nondestructive test for the checking of resistance spotwelds of aluminum.

Another subject which aroused active discussion was the need for educating in electronic practice the electricians who had the responsibility of maintaining and servicing electronic-control equipment. This is still a major problem in expanding the field of electronic devices. It was brought out that intelligent and complete servicing of electronic-control equipment necessitated the use and understanding of the cathode-ray oscillograph, which therefore, must be an early and important part of any such educational program.

The discussion also developed the fact that electrical engineers probably had much to learn as regards some aspects of resistance-welding technique, particularly relationships between thermal and electrical factors.

The following took part in the discussion: H. O. Klinke, B. L. Wise, P. W. La Hue, F. G. de Roza, B. B. Gravitt, Walther Richter, W. G. Dow, D. E. Marshall, H. A. Jones, R. E. Young, W. C. White, S. M. Humphrey, C. E. Mathies, H. C. Steiner. About 50 attended the conference. Of these, 18 were affiliated with manufacturers of electronic-control equipment, 7 with welder manufacturers; 9 with users of welding equipment; 7 with educational institutions, and 6 with public utilities. Several consulting engineers were present, as well as representatives of publications.

MEASUREMENT OF SURFACE FINISH

A combined technical session and conference on instruments and measurements, at which F. B. Silsbee presided, included, in the technical session, the three papers listed in the program, which ultimately will be published in the *Transactions*. The latter part of the meeting was given over to a conference on methods for the measurement and specification of surface finish. About 75 persons were present.

The first conference speaker, W. Mikelson, General Electric Company, emphasized the importance of accurate designation and inspection of machined surfaces in helping speed wartime production. "The performance of a machined surface depends upon the dimensional characteristics of its surface irregularities," Mr. Mikelson said. He named as most important of these characteristics, which vary with different materials and methods of finishing: surface roughness, surface waviness, direction of irregularities in the surface plane, direction of irregularities above or below the nominal plane, pattern of both types of irregularities, surface profile, and contact area with mating parts. Surface roughness is defined by Proposed American Standard *B*46 as the rms height of surface irregularities the peaks of which are less than 1/32 inch apart; surface waviness as the height of deviations of which the peaks are more than 1/32 inch apart. The speaker pointed out that interesting results have been obtained by a few experiments on the effects of finish on performance, although much more research needs to be done. Until practical instruments for measuring surface characteristics are available, a simple method of specifying surfaces in design and production is needed. The General Electric method, which has been used for ten years, uses sample gauge specimens to designate finishes. The symbols describing the specimens designate a specific value of surface roughness. The specimens are used:

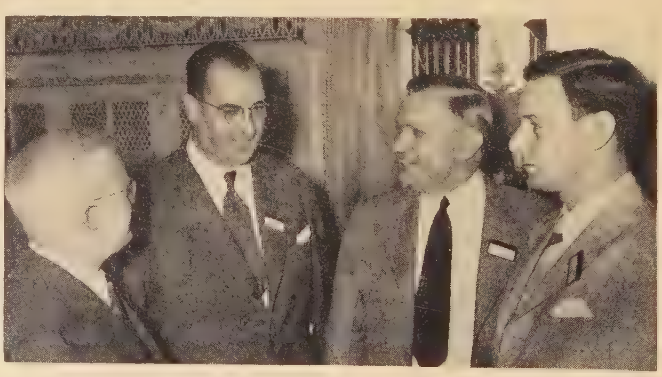
"1. To indicate to the design engineer and to the draftsman the smoothness and appearance of various degrees of finish, and to permit the selection of an exact degree of smoothness for the functional purposes intended.

"2. To enable the shop mechanic to visualize the degree of roughness designated on a drawing.

"3. To enable the shop mechanic and inspector to inspect the product surfaces by comparing them with the proper specimen."

A profilometer which gives a direct reading of surface roughness on an indicating instrument was described by J. R. Wieneke, Physicists Research Company. He showed how this instrument, which makes use of a diamond-tipped stylus that moves over the surface under test, could be applied to test specimens of various shapes. The motions of the stylus are picked up electrically and amplified.

C. K. Gravley, Brush Development Company, described a surface analyzer, also an instrument of the tracer type, which provides a calibrated picture in the form of an oscillographic chart. The measuring head of the instrument consists of a "hill and



Members of the staff of the War Production Board were featured speakers and chairman of the combined session and conference on power generation at the AIEE summer convention. Conferring informally with A. C. Monteith (M'40), Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. (second left), are (left) J. E. Moore (A'12) speaker; (second from right) W. L. Cisler (M'35) chairman, AIEE committee on power generation; and Edward Falck (A'40), speaker, all of War Production Board, Washington, D. C.

dale" crystal pickup, which is moved over the surface by a drive powered by a synchronous motor. The diameter-exploring finger at the end of the pickup carries a positioning shoe and a diamond tracer. The direct-recording oscillograph galvanometer employs another bimorph crystal as an electromechanical transducer. Its sensitivity is independent of frequencies below 60 cycles. A resistance-capacity-coupled three-stage amplifier permits calibrated vertical magnification of tracer-point motions up to 100,000 times, and chart speeds can be selected to give horizontal magnifications of 16, 80, and 400 times. The instrument is relatively simple to operate, he said.

Many questions on the construction and operation of the apparatus were answered by the speakers. The meeting served to acquaint the representatives of the electrical industry present with the status of recent developments in a field of measurement of great importance in the war production effort.

Lighting Aids to War Production Discussed at Conference

The part that good industrial lighting can play in winning the war was stressed at a conference on lighting aids to war production held Monday afternoon, June 22, 1942, during the AIEE summer convention at Chicago, Ill. About 85 persons were present.

Speaking on "What Engineered Lighting Can Do to Aid War Production," Professor J. O. Kraehenbuehl, University of Illinois, said that lighting sales programs of recent years had overemphasized the benefits of quantity, or foot-candles, at the expense of quality, or control of lighting. "If an individual in nutrition emphasized the caloric value of the food and neglected the vitamin content he would be doing what the lighting sales program has been doing the last few years," he said. "The emphasis on the value of those elusive elements in the food, the vitamins, has made the public conscious of some very essential life-giving materials, with the result that many people are living better and the normal wear and tear on the physical being has been reduced. If the same attitude were taken in lighting promotion, the lighting system would not be merely the source of lumens for foot-candles but would be a system for comfortable seeing."

Among essentials of the lighting system besides the quantity, the speaker listed the prevention of glare. "Direct glare from windows, or exposed lights in the line of vision is readily removed by covering the source to lower the brightness or by arrangement of the machines so that the offending source is not in the line of vision. The glare that comes indirectly to the eye, being reflected from either the work or machine or sometimes from some large specular surface within the angle of vision, usually may be removed by introducing low-brightness large-area sources. The point sources which are reflected from curved surfaces are very objectionable.

"Lighting should be uniform, since exposure to regions of high and low illumination requires continued adaptation. There should be good general lighting and, if necessary, supplementary lighting may be used to increase the illumination in special locations. The supplementary light should not be used unless it is uneconomical to reach the higher level of illumination with general lighting, and when it is used there must be a proper balance between the work brightness and the brightness of the surrounding field. Where the illumination is uniform and the vertical component is high there will be few shadows to cause accidents.

"If the lighting installation is properly engineered the workman will be able to produce more efficiently," Professor Kraehenbuehl declared. "He will be able to maintain this production throughout the period of emergency. If the worker is happy in his surroundings his morale will be high, and lighting contributes more to pleasant surroundings than does any other factor in the plant. Saving in spoilage and lack of absences are as great aids to production as is the producing of more pieces, and in addition heighten morale, since injury in either the physical or mental sense is detrimental to the morale of the individual involved and to those associated with him. Good lighting helps the individual who is necessarily slower or has defective eyes. With the call for younger men for combat service much of the production must be carried by the older men who, because of age, are slower and have a higher percentage of defective vision.

"For efficient production, we must add to our promotion of more lumens the element of proper use of those lumens on the work surface."

The timely question of "Substitute Materials for Industrial Lighting Equipment" was discussed by E. D. Tillson, Commonwealth Edison Company. The substance of Mr. Tillson's talk is scheduled for publication in a later issue of *Electrical Engineering*. A. K. Gaetjens, General Electric Company, spoke on "Maintaining Lighting in War Industries." His talk is to be published in a forthcoming issue of *The Magazine of Light* published by his company.

The relation of "Good Industrial Lighting and Safety" was described by J. M. Roche, National Safety Council, who declared that accidents caused entirely or partly by improper illumination represented between 15 and 25 per cent of all industrial accidents in 1941. The total of all such accidents resulted in the estimated loss of 108,000,000 man-days of production time.

Two factors were pointed out as at fault in connection with industrial lighting and accidents: substandard installations and poor maintenance. From the standpoint of the safety engineer, it was stressed that industrial lighting systems should be designed only by lighting experts, not by plant maintenance men or others not entirely familiar with the problems to be met with and overcome.

Daylight illumination was specified as ideal for most industrial operations; however, it is recognized that daylight illumination is impracticable except in a few cases. With the increase of three-shift work, the demand for good artificial lighting systems has greatly increased. The requisites for such a system include:

1. Adequate light for each employee so that he can see clearly, without fatigue or eyestrain, the work which he is doing.
2. All lighting equipment selected and installed to avoid eyestrain.
3. Lights placed so sharp shadows will be avoided on important parts of work. Lamps equipped with reflecting and diffusing devices to soften shadows and avoid glare.
4. An adequate level of general illumination sufficient to avoid the use of local illumination wherever possible.

Other factors that must be taken into consideration include the voltage of the system, the wiring, the illumination level to be maintained, the reflectors to be installed, the room conditions and maintenance requirements, and the types of lamps used.

A periodic system of maintenance for all lighting equipment in the plant should be installed and adhered to rigidly, the speaker said. Decreases in the efficiency of lighting systems of from 20 to 60 per cent were cited, and it was stressed that the efficiency of the lighting system could be maintained to approximately 80 per cent of the original installation through the application of systematic maintenance.

Mr. Roche proposed that the AIEE and the Illuminating Engineering Society work with the National Safety Council in developing information on the lighting and accident problem. His proposal included the study of plant accident records prior to and following the installation of improved lighting systems.

Professor H. B. Dates, chairman of the committee on light in wartime of the Illuminating Engineering Society, described the activities of the IES to aid war production, and especially its work in the development of lighting standards. The timely publication of "American Recommended Practice for Industrial Lighting," which was approved by the American Standards Association March 17, 1942, is the culmination of a series of studies of industrial seeing tasks initiated by the IES through its committees in 1935. Representatives of 23 organizations including AIEE co-operated in its production.

"With round-the-clock operation the rule rather than the exception, good lighting for the seeing tasks of industry is more important than ever before," Professor Dates pointed out, referring to wartime operations. He reviewed in some detail the principal topics covered by the new Standard, and also called attention to another American Standard sponsored by the IES and approved by ASA February 27, 1942, ("Illuminating Engineering Nomenclature and Photometric Standards") which is pertinent to all work on the subject of illumination. Both Standards may be secured from ASA headquarters, 29 West

39th Street, New York, N. Y., or IES headquarters, 51 Madison Avenue, New York.

Meeting of District 4 Executive Committee at Chicago

The Southern District (4) delegates and members present at the 1942 summer convention at Chicago, Ill., held a luncheon meeting on June 23, 1942, which served as a District executive committee meeting. Those who attended were:

J. E. Housley, vice-president, East Tennessee
C. L. Crosby, Virginia
J. P. Hamilton, Muscle Shoals
J. R. Smith, Louisville
N. C. Pearcy, Chicago
J. P. Argo, Memphis
E. A. Bureau, Louisville
E. E. Kilburn, North Carolina
E. W. O'Brien, Georgia
D. R. Baldwin, East Tennessee
A. P. Farrow, East Tennessee
Mark Eldredge, Washington, D. C.
Mead Warren, Jr., East Tennessee
Robert C. Hill, Virginia
Stanley Warth, Florida
J. V. Hay, New Orleans
C. W. Ricker, New Orleans
Wm. J. Miller, Alabama
A. S. Hoefflin, District secretary, Louisville

Plans for the proposed District meeting in Virginia in 1943 were discussed but were held in abeyance because of the curtailment of transportation and the difficulty in securing hotel accommodations. The next District executive committee meeting will be held in Memphis, Tenn., in the fall, providing transportation facilities permit. Among other District and Section affairs discussed was the possibility of holding District meetings jointly with student conferences.

AIEE Board of Directors Meets During Summer Convention

The regular meeting of the board of directors of the American Institute of Electrical Engineers was held at the Drake Hotel, Chicago, on June 24, 1942.

The committee on planning and co-ordination gave a progress report of its study of Institute activities in relation to war needs, and expects to pursue its consideration of this subject and report more fully at the August board meeting. In connection with it, there were presented interim recommendations of the technical program committee along this line, which were approved by the board for immediate application. These recommendations were to the effect that a normal schedule of national conventions and District meetings should be planned, all strictly business in character; where appropriate, local conferences or production clinics may be held under Section auspices, so planned as to require a minimum of traveling for those attending; technical programs and papers should be closely related to the war effort, and programs in general should present practical recommendations, or results of experience, in such forms as will be of most use to those engaged in war production or planning; papers of not sufficient value to the war effort, and papers which cannot be published for censorship reasons, will be held in abeyance for presentation and publication after the emergency.

Upon recommendation of the finance committee, an increase of $5,000 in the appropriation for printing the advertising section of *Electrical Engineering* was voted, to meet the increased printing expense due to advertising revenue in excess of that estimated for the year, and $1,500 was added to the appropriation for printing miscellaneous publications (a self-liquidating item), because of increased demand for Institute publications. Provision was made for the attendance of one or two delegates of the University of Alberta Branch to the joint conference on student activities to be held in Vancouver, in September, during the Pacific Coast convention.

Upon recommendation of the publication, technical program, and finance committees, authorization was given for the issuance as a special publication of the Institute on a self-liquidating basis of a "Bibliography of Electrical Safety Literature, 1930–1941," submitted by the committee on safety.

The board approved the following, as recommended by the Standards committee:

Submission to ASA for approval as an American Standard, of the revision of AIEE Standard No. 4, "Measurement of Test Voltages in Dielectric Tests," which was approved by the board at its May meeting.

A new AIEE Standard, "Apparatus Bushings," developed by a joint committee of the AIEE and the Edison Electric Institute.

A revision of present AIEE Standard No. 22, "Air Switches and Bus Supports," developed by the committee on protective devices.

Revisions of the following four American Standards, which comprise the Sectional Committee project, "Graphical Symbols," for which the AIEE and The American Society of Mechanical Engineers are joint sponsors:

Graphical Symbols for Welding, Z32.1

Graphical Symbols for Electric Power Control and Measurement, Z32.3

Graphical Symbols for Telephone, Telegraph, and Radio Use, Z32.5

Electrical Symbols for Architectural Plans, Z32.9

A brief report was given of the work of the Standards committee which may be considered as aiding the war effort, as evidenced by increased activity of committees engaged in the development of Standards, and increased sales of AIEE Standards, particularly the Marine Rules. The recent development of "Guides for Operation" of transformers and regulators is a direct instance of work accomplished which permits of apparatus under overload conditions now necessary on many installations.

H. S. Osborne tendered his resignation as an AIEE representative on the Electrical Standards Committee of the American Standards Association, and the president was empowered to appoint his successor.

The resignation of W. S. Barstow as a representative of the Institute on the Engineering Societies Library Board was presented and accepted. The appointment of his successor was referred to the president with power.

Upon recommendation of the District meeting committee, authorization was given for the postponement to the earliest propitious time of the Middle Eastern District meeting, previously scheduled to be held in Pittsburgh, Pa., in October 1942.

Other actions taken by the board included the following:

Minutes of the meeting of the board of directors held May 22, 1942, were approved.

A report of a meeting of the board of examiners held June 18, 1942, was presented and approved. Upon recommendation of that board, the following actions were taken: 4 applicants were transferred and 1 was elected to the grade of Fellow; 21 applicants were transferred and 16 were elected to the grade of Member; 108 applicants were elected to the grade of Associate; 80 Students were enrolled.

Disbursements for June, amounting to $27,315.92, were reported by the finance committee and approved by the board of directors.

Those present were:

President—David C. Prince, Schenectady, N. Y.

Past President—F. Malcolm Farmer, New York, N. Y.

Vice-Presidents—J. L. Hamilton, St. Louis, Mo.; K. L. Hansen, Milwaukee, Wis.; N. S. Hibshman, Bethlehem, Pa.; J. Elmer Housley, Alcoa, Tenn.; Arthur L. Jones, Denver, Colo; Everett S. Lee, Schenectady, N. Y.; Walter C. Smith, San Francisco, Calif.; A. LeRoy Taylor, Salt Lake City, Utah.

Directors—T. F. Barton and H. S. Osborne, New York, N. Y.; M. S. Coover, Ames, Iowa; Mark Eldredge, Washington, D. C.; C. M. Laffoon, East Pittsburgh, Pa.; T. G. LeClair and L. R. Mapes, Chicago, Ill.; F. J. Meyer, Oklahoma City, Okla.; W. B. Morton, Philadelphia, Pa.; R. G. Warner, New Haven, Conn.

National Treasurer—W. I. Slichter, New York, N. Y.

National Secretary—H. H. Henline, New York, N. Y.

By Invitation: Officers-Elect—A. G. Dewars, Minneapolis, Minn.; C. R. Jones, New York, N. Y.; E. T. Mahood, Kansas City, Mo.; K. B. McEachron, Pittsfield, Mass.; E. W. Schilling, Bozeman, Mont.

AIEE Radio Program Expanded in Co-operation With Other Societies

The success of the Institute's 1941 series of radio broadcasts led the AIEE Board of Directors at its August 1941 meeting to authorize President Prince to appoint a committee of three AIEE members to approach other engineering societies with a proposal for joint sponsorship of a new and broader program of radio broadcasts, covering the work of the engineer in various fields. The proposal ultimately won the co-operation and financial support of the American Society of Civil Engineers, The American Society of Mechanical Engineers, and the American Institute of Chemical Engineers. Accordingly, a joint committee of three representatives from each of these societies was established, with AIEE Vice-President E. S. Lee as chairman.

This joint committee went to work in the fall of 1941 and, with the consultation and advice of Doctor James Rowland Angell, public service counselor for the National Broadcasting Corporation, began the development of a program intended to reflect the varied contributions of engineers to the prosecution of the war effort. The

Japanese assault on Pearl Harbor stimulated the activity, especially with reference to completion of the work that had been started on script concerning blackouts, bombs, and explosion damage to structures.

As indicated in the accompanying schedule for the broadcasts, all material is being prepared by or under the direction of eminent authorities. The National Broadcasting Company and the Office of Civilian Defense have endorsed the program and given generous help in the preparation and approval of scripts. The program, as announced June 29, is given in the accompanying tabulation.

The Engineer at War

Broadcasts 6:30 to 6:45 p.m. NBC Network

1. July 16. Blackouts. Representative of the Office of Civilian Defense and S. G. Hibben (A'34) Westinghouse Electric and Manufacturing Company.
2. July 23. Protection Against Incendiary Bombs and Gas. Sidney D. Kirkpatrick, president, American Institute of Chemical Engineers, and Doctor Arthur Ray.
3. July 30. The Resistance of Structures. Professor H. E. Wessman, New York University, and Walter D. Binger, commissioner of Borough Works, Manhattan.
4. August 6. The Navy; Ships. Admiral S. M. Robinson.
5. August 13. Dry Docks and Ship-Repair Bases. Rear Admiral Ben Moreell.
6. August 20. Tanks and Tools Prepared by the Chrysler Corporation.
7. August 27. Airplanes. Prepared by the Wright Aeronautical Corporation.
8. September 3. Petroleum Production. Prepared by Robert E. Wilson, president, Pan American Petroleum Company.
9. September 10. Power, Hydro and Steam Electric. Glen B. Warren, General Electric Company, and others.
10. September 17. United States Engineers Corps in Peace and War.
11. September 24. Communications in Action.

Future AIEE Meetings

Pacific Coast Convention
Vancouver, B. C., September 9–11, 1942

Winter Convention
New York, N. Y., January 25–29, 1943

ABSTRACTS • • •

TECHNICAL PAPERS previewed in this section will be presented at the AIEE Pacific Coast convention, Vancouver, B. C., September 9–11, 1942, and are expected to be ready for distribution in advance pamphlet form within the current month. Copies may be obtained by mail from the AIEE order department, 33 West 39th Street, New York, N. Y., at prices indicated with the abstract; or at five cents less per copy if purchased at AIEE headquarters or at the convention registration desk.

Mail orders will be filled AS PAMPHLETS BECOME AVAILABLE

Basic Sciences

42-152—History of A-C Wave Form, Its Determination and Standardization; *Frederick Bedell (F'26). 15 cents.* With the birth of the transformer and the first distribution of alternating currents, interest in wave form grew and methods were developed for its determination, chiefly point-by-point method of instantaneous contact, mechanical oscillograph, cathode-ray oscillograph, and the oscilloscope with stabilized time-axis. The point-by-point method, by which were made the first major contributions, is now practically superseded by oscillograph and oscilloscope, each finding increasing use in its field. With the determination of wave form accomplished, demand arose for its standardization corresponding to expanding applications. No single standard being suited to all applications, different standards have been developed in different fields, as in power, communication, and insulation. While it is desirable that standards, once set up, remain fairly stable, they should be subject to review and occasional change to keep in step with technological advances. Minor revision in communication is in progress. Although standards in other fields do not appear ideal, revision may be deferred.

42-158—Inverse Functions of Complex Quantities; *H. B. Dwight (F'26). 15 cents.* Formulas for inverse functions of complex quantities such as $\sin^{-1}(x+iy)$, are of use in several branches of electrical engineering. Calculations for transmission circuits require them, particularly in connection with communication circuits. Integration of expressions involving complex quantities can involve inverse functions. They are encountered also in conformal transformations. In presenting the formulas in this paper, it is necessary to specify angles with sufficient detail to avoid ambiguity and the liability of incorrect results. Also, all of the appropriate multiple values should be included. It is not always obvious by inspection that two different complex values are only values of different branches of the same function and are both correct. In all cases, numerical examples are given as illustrations.

Electrical Machinery

42-156—Interim Report on Guides for Overloading Transformers and Voltage Regulators; *transformer subcommittee of the AIEE committee on electrical machinery. 15 cents.* The present war emergency has crystallized the need for additional information concerning the maximum load capability of modern-design transformers and voltage regulators in order that these apparatus may be utilized to a greater extent for meeting present and new load requirements with a minimum amount of new equipment, thus conserving critical war materials. The relation between the life expectancy of insulation as indicated by laboratory tests and the actual life of a transformer is largely theoretical so that the use of such information must be tempered by sound judgment based on operating experience. This report represents a compromise of views that is considered conservative and satisfactory for immediate general use subject to the limitations and cautions given herein. Consideration is given to operation with normal life expectancy and also with moderate sacrifice in life expectancy, thus taking into account the effect of the following factors:

a. Characteristics and limitations of the apparatus involved
b. Ambient temperature
c. Load factor
d. Supplemental cooling
e. Sacrifice of life expectancy

Industrial Power Applications

42-154—Application of Vacuum-Tube Oscillators to Induction and Dielectric Heating in Industry; *J. P. Jordan. 15 cents.* High-frequency inductive and dielectric heating has in recent years become a very important factor in industry. Frequencies up to 1,000,000 cycles are used for inductive heating and from 1,000,000 to 30,000,000 cycles for dielectric heating. The lower frequencies are most generally used for forging and melting; intermediate frequencies (obtained from rotating machines) are used in practically all heating processes; the higher frequencies (obtained from spark-gap and vacuum-tube oscillators) are used for surface-hardening small or irregularly shaped parts and for heating low resistance metals for brazing and soldering. For the heating of nonmetallic materials such as plywood and plastics by the dielectric loss method, vacuum-tube oscillators must be used because of the high frequencies involved. In inductive heating, the heat is generated largely by eddy currents induced in the surface of the metal. Using this effect, vacuum-tube oscillators have made possible many new applications in the fields of surface hardening, brazing, and soldering. Its advantages are extreme localization of the heat, speed, cleanliness, and uniformity of results.

Power Transmission and Distribution

42-146—A Practical Discussion of Problems in Transformer Differential Protection; *P. W. Shill. 25 cents.* The war has brought about more insistent demands for relay systems of high degrees of reliability and selectivity. At the same time, much obsolete equipment is being reconditioned and put back into service, while the usual supplies of suitable material and equipment to build first-class protective systems have been largely curtailed or completely denied to the engineers responsible for relay protection. The question of the current differential protection of transformer banks is discussed from the simplest to complex cases. The protection of three-phase delta-zigzag-wye transformer banks, and the protection of three-phase to two-phase

Scott-connected transformer banks are discussed, for what is believed to be the first time. Tolerances and compensating factors which can be made use of in the design of transformer differential protections are discussed, and specimen tables have been worked out. The use of ordinary overcurrent relays for transformer differential protection is discussed with special application to systems of small generating capacity.

42-148—Design, Manufacture, and Installation of 120-Kv Oil-Filled Cables in Canada; *D. M. Farnham, O. W. Titus (M '36). 25 cents.* This paper describes the 120-kv oil-filled cable system of the Montreal Light, Heat, and Power Consolidated, installed during 1941 and in present operation as a link in a large interconnection scheme. The paper describes the functions of the various sections of the system and the reasons for the choice of this method of effecting the interconnection. The steps required in designing the cable system are outlined and the general principles governing each such step discussed. A short section dealing with manufacture is followed by a section covering the organization required for installation and the methods followed. The final section deals with operating practice, especially the basis of loading.

42-149—Method for A-C Network Analysis Using Resistance Networks; *W. E. Enns (A '37). 20 cents.* A new method of calculating a-c network problems is described and illustrated with a practical example. The scope of the present paper is limited to the use of the conventional d-c calculating board for making load distribution and voltage studies for three-phase networks with balanced loading. In contrast with the a-c network analyzer this method is not inherently exact, but by successive approximations an exact solution may be obtained. Fortunately, the first approximation gives results of sufficient accuracy for most practical problems and rarely is it necessary to carry the solution beyond a second approximation. The practical example in the paper shows that the procedure is simple and also quicker than other methods of analyzing complex networks with the exception of the a-c analyzer. Therefore the new method should become a useful tool for engineers in system planning work.

42-150—Power System Interconnection in Quebec; *W. R. Way. 25 cents.* The paper describes the development of three of the large power systems in the Province of Quebec, which, due to the urgent demand for prime power for defense purposes, have been suitably interconnected. These systems are supplied exclusively from hydroelectric plants, and it is pointed out that the load characteristics and power available on each subsystem are not ideally matched, but when operated as an integrated system, these characteristics become complementary. A study of the problem, illustrated by means of curves, indicates that when operated as an interconnected group, 18 per cent of the total power resources may be reclaimed and made available for sale as prime power. This surplus would otherwise be wasted or disposed of as electric-boiler power, and reference is also made to control of reactive power, voltage, frequency on the interconnected system, as well as to stability and short-circuit problems. Total resources on the combined system to the extent of nearly 4,000,000 horsepower are involved.

42-153—Three-Winding Transformer Ring Bus Characteristics; *G. W. Bills (A '38), C. A. MacArthur. 15 cents.* For generating stations sending large blocks of power over several high-voltage transmission lines the use of three-winding transformers connected so as to form a ring bus on the low-voltage side with no high-voltage bus or breakers offers certain advantages. Studies were made on a network analyzer to determine power limits and fault currents on a system having a three-winding transformer ring bus. Then, for comparison, similar studies were made on the same transmission system using a standard high-voltage bussing arrangement. The studies indicate that the transient power limits are practically independent of the reactance between low-voltage windings as it varies from 0 to 40 per cent. The use of the higher reactance gives equal or lower short-circuit currents than are obtained on the standard system, while the transient stability power limits are nearly 10 per cent higher.

Protective Devices

42-147—A New Single-Pole Service Restorer; *E. E. Tugby. 15 cents.* With the advent of increased rural electrification there has come a definite requirement for high quality service at the lowest possible cost. The single-pole service restorer described in this paper is a marked advance in protective equipment and has a number of features not heretofore found in equipment of its general type, at a very low first cost. The operating energy of the device is contained in a spring, which is rewound after each operation by a motor of unique and interesting design. This motor has no commutator and needs no secondary source of operating energy, as the operating coils are in series with the primary line. Maximum use is made of all component parts and in one case, a device performs two functions. The use of this new restorer will allow closer co-ordination on rural electric systems and will make available a much higher class of service than available heretofore. Adjustments are provided that make this unit a very flexible device.

ACO-42-151—Some Canadian Developments in Relays and Relay Applications; *E. G. Ratz (A '19). 20 cents.* The paper describes features of some Canadian relay developments, among which are the necessity of selecting proper value of generator field discharge resistance to obtain maximum speed of protection; a relay to protect generators on short circuit when the short-circuit current may be less than full-load current; a self-resetting over voltage protection; a method of detecting field circuit grounds; experience with simple transformer protection arranged to give high speed on heavy faults; performance of coupling capacitors on sudden drop and recovery of line voltage; methods of using impedance relays to give faster than timed protection in the "end zones"; and use of and experience with impedance relays for phase-to-ground protection.

42-155—Design and Operation of High-Voltage, Axial Air-Blast Circuit Breakers; *A. K. Leuthold. 20 cents.* For selective protection of interconnected high-voltage transmission systems, fast operating circuit breakers are of great importance and as a large proportion of the system faults are of a transient nature, the system stability can be considerably increased by fast tripping and high-speed reclosing of the faulty phase only. Experiences have shown that compressed air is most suitable for arc-extinction and fast breaker operations. This paper presents the design and operation experiences of 150 kv and 220 kv axial air-blast circuit breakers and illustrates an air-blast breaker suitable for extremely high voltages and rupturing capacity, achieved from extensive research work and operation experiences. This particular breaker design, which consists of potential-controlled, multiple arc-breaks, guarantees equal voltage distribution between the different arc-breaks and therefore permits, in spite of the present limited test plants, judging the breaker performance under full rated breaking capacity.

42-157—Some Air-Blast Circuit-Breaker Installations in Canada; *H. W. Haberl (A '28), R. A. Moore. 15 cents.* This paper is intended to show pictorially a number of air-blast circuit-breaker installations in Canada in the range of from 4 to 230 kv. Of the various types of circuit breakers discussed in this paper, there are in service in Canada 23 air-blast breakers of the 69-, 138-, and 230-kv types. There are also in operation 37 breakers on 13- and 4-kv service. Numerous short-circuit tests and oscillograms have been incorporated in the paper. These tests justify the manufacturer's interrupting ratings of some of the types of air-blast breakers shown.

PERSONAL • • • •

H. N. Blackmon (M'32) manager of the Westinghouse Editorial Service, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been presented the Westinghouse Order of Merit for his "outstanding ability to interpret Westinghouse engineering achievements to editors of technical and trade magazines and for his honesty of opinions and ability to teach editorial techniques and philoso-

phy." He has been with the company since 1925. **R. E. Marbury** (M'36) section engineer, capacitor section, switchgear engineering department, also was awarded the Order of Merit for his "advanced engineering ideas." **James Boyd** (M'40) eastern district manager, New York, N. Y., likewise was honored "for his clearsighted, practical sales ability in serving a complicated metropolitan area; for his management of a sales organization under difficult conditions existing in that area; and for his personal salesmanship and courage in handling large and difficult negotiations." He joined the company in 1917. **R. C. Bergvall** (A'24, M'41) assistant to the vice-president in charge of engineering at Pittsburgh, Pa., also has been cited "for his broad knowledge of the design, application, and performance characteristics of Westinghouse apparatus and for his ability to co-ordinate and guide engineering efforts and activities to the best interest of the company." He joined the company in 1921. **C. W. Drake** (A'20, M'21) manager, general mill section, industry engineering department, East Pittsburgh, Pa., likewise has been honored for "his broad knowledge and appreciation of the electrical problems of industry and his ability to analyze, explain, and solve them, and for his unstinting efforts and excellent success in the instruction of younger men." He has been employed by the company since 1905.

W. R. Work (A'07, F'40) head of the electrical engineering department, Carnegie Institute of Technology, Pittsburgh, Pa., has been appointed assistant director of the college of engineering. He was born at Steelton, Pa., on May 4, 1881, and received the degree of bachelor of arts from Wittenberg College in 1902 and that of master of engineering in electrical engineering from Ohio State University in 1905, as well as the honorary degree of doctor of science from Wittenberg College in 1920. After a year with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., he became instructor in electrical engineering at Carnegie Institute of Technology in 1906. He became assistant professor in 1909, associate professor in 1915, and professor in 1921. During 1920–21 he was acting head of the department of electrical engineering in addition to serving as consulting electrical engineer with Morris Knowles, Inc., Pittsburgh, Pa., and in 1921 he was made head of the department of electrical engineering. From 1921 to 1930 he also maintained private practice as a consulting electrical engineer. He is a member of Sigma Xi, Tau Beta Pi, and Eta Kappa Nu, as well as the American Association for the Advancement of Science and the Society for the Promotion of Engineering Education.

M. L. Manning (A'36, M'42) research engineer, insulation development section, Westinghouse Electric and Manufacturing Company, Sharon, Pa., has been appointed associate professor of electrical engineering at Illinois Institute of Technology, Chicago. He received from South Dakota State College in 1927 the degree of bachelor of science and that of master of science from the University of Pittsburgh in 1932. He joined the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., in 1927 and after a year as designer of electric apparatus with the Sullivan Machinery Company, Claremont, N. H., returned to the Westinghouse Electric company as industrial motor engineer. In 1932 he joined the mathematics department of the University of Pittsburgh as instructor. He continued graduate work in mathematics and in 1936 returned to the Westinghouse Electric and Manufacturing Company as transformer design engineer, instrument transformer section, Sharon, Pa. In 1937 he was appointed supervisor of the high-voltage laboratories and Westinghouse lecturer in electrical engineering on the staff of the University of Pittsburgh. He has been serving currently as chairman of the AIEE Sharon Section.

J. F. Toomey (A'19) of the switching development department, Bell Telephone Laboratories, Inc., New York, N. Y., retired on April 30, 1942. He was born on April 9, 1878, at Boston, Mass. From 1892 to 1900, he was associated with the New England Telephone and Telegraph Company, Boston, Mass., and in 1900 he joined the engineering department of the Roland Oakes Company, Holyoke, Mass. He returned to the engineering department of the New England Telephone and Telegraph Company, Boston, Mass., in 1901 and in 1904 joined the engineering department of the American Telephone and Telegraph Company, Boston, Mass. He was transferred later to that company's New York office. In 1919 he entered the department of development and research, where he worked on the development of toll circuits and long-distance projects. In 1925 he became associated with the Bell Telephone Laboratories and was placed in charge of the analysis of toll systems in the toll development department. Later, in the switching development department he worked on special problems relating to toll switching systems. He holds a number of patents on communications devices.

A. W. Henshaw (A'06, F'13) General Electric Company, Schenectady, N. Y., retired recently. He was born August 19, 1872, at Easthampton, Mass., and was graduated from Lehigh University with the degree of electrical engineer in 1894. In 1895 he was employed in the laboratory of the Electro-Dynamic Company, Philadelphia, Pa., and in 1896 he joined the testing department of the General Electric Company, Schenectady, N. Y. He was transferred in 1897 to the engineering department, where he worked on the design of induction motors. In 1903 he was appointed commercial engineer in the industrial department and in that year went to Pittsfield, Mass., as commercial engineer in charge of induction motors for the Stanley Electric Manufacturing Company, which later became the Pittsfield works of the General Electric Company. He returned to the General Electric Company, Schenectady, N. Y., as a member of the engineering department in 1907 and later joined the induction motor and manufacturing general departments. In 1925 he was transferred to the commercial general department, and later was placed in charge of all General Electric association relationships.

E. M. Wood (A'09, M'25) planning engineer, Hydro-Electric Power Commission of Ontario, Toronto, and co-author with A. H. Frampton (M'28) of the paper, "The 220,000-Volt System of the Hydro-Electric Power Commission of Ontario," has received the 1941 AIEE District 10 prize for best paper. He was born on May 21, 1882, at Norfolk County, Ont., and received the degree of bachelor of applied science from the University of Toronto in 1908. He joined the Hydro-Electric Power Commission in 1909 as an inspector and from 1910 to 1913 he was assistant to the superintendent of construction. In 1913 he became engineer in charge of the complaint section, engineering department, Canadian General Electric Company, Toronto, Ont., and from 1917 to 1919 he was superintendent of the power section and safety engineer, Consolidated Mining and Smelting Company, Trail, B. C. In 1919 he returned to the Hydro-Electric Power Commission of Ontario as assistant engineer, station section, electrical engineering department. He served as chairman of the AIEE Toronto Section, 1928–29.

D. D. Ewing (A'11, F'21) professor of electrical engineering, Purdue University, Lafayette, Ind., has been appointed head of the school of electrical engineering and director of the electrical laboratory. He was born at Vanlue, Ohio, October 7, 1883, and was graduated in 1906 with the degree of mechanical engineer from Ohio Northern University, from which he received the honorary degree of doctor of engineering in 1936. After serving as an assistant engineer with the Missouri Pacific Railway, St. Louis, and the Hocking Valley Railway, Logan, Ohio, he became professor of electrical and mechanical engineering at Ohio Northern University, Ada, Ohio, in 1907. He was appointed assistant professor of electric railway engineering at Purdue University in 1913, later becoming associate professor, and in 1918 becoming professor. Since 1910 he has also been a consulting engineer. He is the coauthor of a book, "Electric Railway Engineering" and the author of a number of technical articles. He is also a member of the Society for the Promotion of Engineering Education and Eta Kappa Nu.

E. W. Boehne (A'29, M'37) research engineer, power circuit breaker engineering department, General Electric Company,

Philadelphia, Pa., has received the 1941 AIEE District 2 prize for best paper for his paper, "The Geometry of Arc Interruption." He was born on June 2, 1905, at Laramie, Wyo., and received the degree of bachelor of science in 1926 from Texas Agricultural and Mechanical College, and that of master of science in 1928 from Massachusetts Institute of Technology. He was employed by the General Electric Company, Lynn, Mass., from 1926 to 1928, when he was transferred to the company's high-voltage engineering laboratory at Pittsfield, Mass. Later in 1928 he went to Schenectady, N. Y., where he was employed in the engineering general department until 1933 when he joined the switchgear engineering department at Philadelphia. He was later transferred to the circuit-breaker engineering department. He received honorable mention in the selection of outstanding young engineer for 1936 by Eta Kappa Nu. He is also a member of the Franklin Institute.

H. M. Shockley (A'25) assistant switchgear sales engineer, Canadian General Electric Company, Ltd., Toronto, Ont., has been awarded the 1941 AIEE District 10 prize for initial paper for his paper, "The Selection of Switchgear for Industrial Plants." He was born at Macclesfield, England, on March 18th, 1901, and received the degree of bachelor of applied science in electrical engineering from the University of Toronto in 1922. In that year he entered the test department of the Canadian General Electric Company, Ltd., Peterboro, Ont., and from 1924 to 1926 he was engaged in switchgear design. In 1936 he was transferred to the switchgear sales engineering department at Toronto. After being associated with A. J. F. Montabone, consulting engineer, Montreal, P. Q., from 1929 to 1935, he returned to the switchgear-application and sales department of the Canadian General Electric Company.

J. H. Cox (A'25) section engineer, mercury-arc rectifier engineering department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., co-author with H. C. Myers of the paper, "Excitation Circuits for Ignitron Rectifiers," has been awarded honorable mention in the 1941 AIEE national prize award for best paper in engineering practice. He received the degree of bachelor of science in electrical engineering from Massachusetts Institute of Technology in 1923. From 1917 to 1919 he was in the marine engineering department of the United States Navy. In 1923 he joined the service department of the Westinghouse Electric company with headquarters at New York and in 1924 he was transferred to the porcelain insulator and transmission department at East Pittsburgh. Since 1929 he has been engaged in the development and design of power mercury-arc rectifiers.

A. H. Frampton (A'21, M'28) assistant electrical engineer, Hydro-Electric Power Commission of Ontario, Toronto, and co-author with E. M. Wood (M'25) of the paper, "The 220,000-Volt System of the Hydro-Electric Power Commission of Ontario," has received the 1941 AIEE District 10 prize for best paper. He was born on May 23, 1899, at Gillingham, Kent, England, and was graduated from the University of Toronto in 1925 with the degree of bachelor of applied science. He was engaged in construction and installation work with the G. J. Beattie Company, Toronto, Ont., from 1915 to 1917, when he became laboratory assistant with the Hydro-Electric Power Commission of Ontario. After studying at the University of Toronto (1921–25) he returned to the electrical-engineering department of the Hydro-Electric Power Commission in 1925.

I. A. Terry (A'27, F'37) works manager's office, General Electric Company, Schenectady, N. Y., has been made general assistant to the vice-president in charge of design engineering, apparatus department. Born in Ogden, Utah, on October 31, 1903, he received the degrees of bachelor of science in electrical engineering from the University of Utah in 1925 and master of science in electrical engineering from Union College in 1929. In 1925 he entered the student test course, General Electric Company, Schenectady, N. Y., and in 1927 was transferred to the a-c engineering department. From 1930 to 1933 he worked on the development and research in the a-c engineering department and in 1933 he became assistant engineer in the motor and generator engineering department. In 1940 he was appointed assistant in the office of the works manager.

Earle Wild (A'27, M'36) load dispatcher, Commonwealth Edison Company, Chicago Ill., has received honorable mention in the 1941 AIEE national prize award for best paper in engineering practice for his paper, "Methods of System Control in a Large Interconnection." He was graduated from Massachusetts Institute of Technology with the degree of bachelor of science in electrical engineering in 1924. In that year he joined the Commonwealth Edison Company as station operator at the northwest station. From 1928 to 1930 he was assistant efficiency engineer and from 1931 to 1935 he was load dispatcher. In 1935 he became technical assistant to the chief load dispatcher, working on the study of interconnection operating and automatic load-control problems.

T. A. Rich (A'41) electrical engineer, general engineering laboratory, General Electric Company, Schenectady, N. Y., has received the 1941 AIEE District 1 prize for best paper and initial paper for his paper, "Ampere-Squared-Second Recorder." He was born on June 18, 1905, at Lynn, Mass., and received the degree of bachelor of science in electrical engineering in 1930 from Harvard University. From 1923 to 1927 he was employed in the standardizing laboratory of the General Electric Company, in West Lynn, Mass. In 1930 he joined the carrier-current section of the radio department, General Electric Company, Schenectady, N. Y., and in 1933 was transferred to the general engineering laboratory. He is the holder of numerous patents.

E. H. Eacker (A'25) assistant to the president, Boston (Mass.) Consolidated Gas Company, has been elected vice-president in charge of the electrical division and investigating department. He was born at Buffalo, N. Y., on December 15, 1899, and received the degrees of bachelor of science and master of science from Massachusetts Institute of Technology in 1923. He was employed by the General Electric Company from 1920 to 1923, when he became assistant superintendent of electric distribution, Charlestown (Mass.) Gas and Electric Company. He was made superintendent in 1925 and local manager in 1930. He was appointed assistant to the vice-president in charge of the Boston District, Boston Consolidated Gas Company, in 1931, and in 1936 was made assistant to the president.

H. Y. Hall (A'03, F'27) former superintendent of Waterside station, Consolidated Edison Company of New York (N. Y.), has been appointed production superintendent. He has been with the company and its predecessor, the United Electric Light and Power Company, since 1921. **H. A. Bauman** (A'26, M'41) assistant superintendent, production department, Brooklyn (N. Y.) Edison Company, has become electrical superintendent. He was employed by the New York Edison Company in 1926, remaining as assistant superintendent of the Waterside station when that company became a part of the Consolidated Edison Company of New York in 1936. He joined the Brooklyn Edison Company in 1938.

D. S. Hilborn (A'06, M'40) senior staff engineer, general engineering department, Eastern area, Bell Telephone Company of Pennsylvania, Philadelphia, retired recently. He was born on March 19, 1877, in New Orleans, La., and received the degree of bachelor of science in electrical engineering in 1899 from the University of Pittsburgh. From 1899 to 1912 he was engaged in field work, construction, and maintenance for the Bell Telephone Company of Philadelphia and the Bell Telephone Company of Pennsylvania, and from 1912 to 1917 he was testing engineer, plant department, with the latter company. In 1917 he became assistant engineer, general engineering department, and in 1926 senior staff engineer.

J. D. McCrumm (A'36) assistant professor of electrical engineering, Swarthmore (Pa.) College, has received the 1941 AIEE District 2 prize for initial paper for his paper, "An Experimental Investigation of Subharmonic Currents." He was born at Colorado Springs, Colo., on April 17, 1912,

and received the degrees of bachelor of science in electrical engineering in 1933 and master of science in 1934 from the University of Colorado. In 1934 he entered the test course of the General Electric Company, Schenectady, N. Y., and in 1935 became instructor in electrical engineering at Swarthmore College. He is also a member of the Society for the Promotion of Engineering Education.

W. H. Norman (A'39) operation and engineering department, American Telephone and Telegraph Company, New York, N. Y., has been appointed staff engineer in that department. He was born in New York, N. Y., on December 17, 1895, and received the degree of bachelor of science from Carnegie Institute of Technology in 1917. From 1920 to 1926 he was engineering assistant with the Chesapeake and Potomac Telephone Company, Washington, D. C. In 1926 he joined the American Telephone and Telegraph Company as engineer and in that capacity worked on engineering cost studies. In 1930 he was transferred to the operating results division.

B. W. Pike (Enrolled Student) co-author with L. K. Davis of the paper, "Localized Annealing of Rock-Bit Bodies by Sixty-Cycle Induction Heating," has received the 1941 AIEE District 7 prize for Branch paper. He was born at Trinity, Tex., on October 2, 1914, and received the degree of bachelor of science in electrical engineering in 1942. After being associated with the Shell Oil Company as radio technician in the geophysical research laboratory for two years, he joined the Reed Roller Bit Company, Houston, Tex., working there while studying at Rice Institute. He is currently engaged in research on a high-frequency induction process.

R. E. Hedges (Enrolled Student) has received the 1941 AIEE District 8 prize for Branch paper for his paper, "An Electrical Method for Automatic Musical Transposition." He was born at New Philadelphia, Ohio, on August 16, 1920, and has been a student at the University of Southern California since 1938. He plays several musical instruments, and his study of music prompted the development of the device which is the subject of his paper. At present, he is working in the electrical research department of the Douglas Aircraft Company, Inc., Santa Monica, Calif. He is also a member of Eta Kappa Nu and Sigma Xi.

G. B. Tebo (A'36) testing engineer, Hydro-Electric Power Commission of Ontario, Toronto, has received honorable mention in the AIEE 1941 national prize award for initial paper for his paper, "Measurement and Control of Conductor Vibration." He received the degree of bachelor of applied science from the University of Toronto in 1929 and in that year became assistant engineer in the operating department of the Hydro-Electric Power Commission of Ontario with headquarters in Hamilton. He was made assistant testing engineer of the Commission's laboratories at Toronto in 1931 and later became testing engineer.

W. H. Huggins (Enrolled Student) Oregon State College, Corvallis, Oreg., has received honorable mention in the 1941 AIEE national prize award for Branch paper for his paper, "Design of the Low-Frequency Characteristics of Video Amplifiers." He received the degree of bachelor of arts from Oregon State College in 1941. He was chairman of the Oregon State College Branch AIEE, 1940–41, is a student member of the Institute of Radio Engineers, and is a member of Sigma Xi, Tau Beta Pi, and Eta Kappa Nu. He was awarded the 1940 AIEE national prize award for Branch paper (*EE, July '41, p. 353*).

A. M. McQuarrie (A'41) aircraft instrument engineering department, Canadian General Electric Company, Ltd., Peterboro, Ont., and co-author with H. G. Mah (A'41) and C. R. Hoar of the paper, "The Predetermination of the Regulation of Salient-Pole Alternators," has received the 1941 AIEE District 10 prize for Branch paper. He was born at Edson, Alberta, on August 16, 1914, and received the degree of bachelor of science in electrical engineering in 1940 from the University of Alberta. He joined the Canadian General Electric Company, Ltd., in 1941 as a test student.

V. Petrucelly, Jr. (Enrolled Student) has received honorable mention in the 1941 AIEE District 3 prize award for Branch paper for his paper, "An Automatic Intercommunicating System." In 1933 he was employed by the New York (N. Y.) Telephone Company in the commercial department and in 1936 was transferred to the plant department. During this time he attended night school at Cooper Union and was graduated from that institution with the degree of bachelor of electrical engineering in 1942. He is doing graduate work at present in cathode-ray oscillography at Brooklyn Polytechnic Institute.

H. G. Mah (A'41) engineering department, Burlec, Ltd., Toronto, Ont., and co-author with A. M. McQuarrie (A'41) and C. H. Hoar of the paper, "The Predetermination of the Regulation of Salient-Pole Alternators," has been awarded the 1941 AIEE District 10 prize for Branch paper. He was born at Cranbrook, B. C., on July 18, 1917, and was graduated from the University of Alberta with the degree of bachelor of science in electrical engineering. In 1940 he was employed by the Canadian Car and Foundry, Ltd., Fort William, Ont., and in 1941 he joined the Burlec company.

H. L. Olesen (M'27) assistant general sales manager, Weston Electrical Instrument Corporation, Newark, N. J., has been appointed to serve on the newly formed combat instruments industry advisory committee of the division of industry operations, War Production Board. **H. P. Sparkes** (A'21, M'25) sales manager, meter division, Westinghouse Electric and Manufacturing Company, Newark, N. J., and **D. J. Angus** (A'09, M'34) president, Esterline-Angus Company, Indianapolis, Ind., also have been appointed members of the committee.

D. R. Shoults (A'35) industrial engineering department, General Electric Company, Schenectady, N. Y., has been appointed engineer in the aviation division of that company's industrial department. He was born on June 23, 1903, at Storms, Ohio, and received the degree of bachelor of science from the University of Idaho in 1925. In that year he entered the test course of the General Electric Company and was engaged in test work until 1929 when he joined the industrial engineering department.

A. J. Dolan (A'42) electrical engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has received the 1941 AIEE District 3 prize for Branch paper for his paper, "The Design and Construction of a Vacuum-Tube Voltmeter for Educational Use." He was born at Richmond Hill, N. Y., on May 17, 1918, and received the degree of bachelor of electrical engineering in 1941. In that year he joined the Westinghouse Electric and Manufacturing Company. He is also a member of Eta Kappa Nu.

C. L. Dudley (A'23, M'29) division superintendent, electric distribution department, Public Service Electric and Gas Company, Camden, N. J., has been appointed division superintendent, Essex division. He was first employed by that company as a cadet engineer in 1920. In 1922 he became field engineer in the distribution department; and in 1926 he was transferred to the office of the distribution engineer; and during 1927–28, he was acting district superintendent in charge of distribution.

F. H. Slaymaker (A'42) engineer, Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has received the 1941 AIEE District 6 prize for Branch paper for his paper, "Frequency Response and Efficiency Measurements of a Loud-Speaker." He was born at Lincoln, Nebr. on April 22, 1914, and was graduated from the University of Nebraska in 1941 with the degree of bachelor of science in electrical engineering. He has been with the Stromberg-Carlson company since 1941.

L. K. Davis (Enrolled Student) test engineer, General Electric Company, Schenectady, N. Y., and co-author with B. W. Pike (Enrolled Student) of the paper, "Localized Annealing of Rock-Bit Bodies by Sixty-Cycle Induction Heating," has received the 1941 AIEE District 7 prize for Branch paper. He was born on November 25, 1920, and received the degree of bachelor of science in electrical engineering from Rice Institute in 1942. He recently joined the General Electric Company.

W. C. Brown (A'42) student engineer, General Electric Company, Erie, Pa., has received honorable mention in the 1941 AIEE national prize award for Branch paper for his paper, "The Application of the Amplidyne as a Voltage Regulator." He was graduated in 1941 with the degree of bachelor of science in electrical engineering from the University of Colorado. He has been with the General Electric Company since 1941.

C. G. Smith (A'37) assistant engineer, Pacific Gas and Electric Company, San Francisco, Calif., has joined the switchgear engineering section of the General Electric Company, Philadelphia, Pa. He had been with the Pacific Gas and Electric Company since 1936.

C. L. Proctor (A'08) president and general manager, Toledo (Ohio) Edison Company recently was named salvage co-ordinator for Toledo, Ohio, at a meeting of War Production Board representatives with the local Chamber of Commerce.

L. C. Reed (A'38) manufacturers agent, New Orleans, La., has been awarded "a golden anniversary 50-year certificate" by the Electrical Association of New Orleans in recognition of his pioneering work in the electrical industry.

A. C. Streamer (A'10, M'41) vice-president, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been elected a vice-president of the National Electrical Manufacturers Association.

C. A. Hahn (M'22) in charge of engineering for the H. J. Heinz Company, Pittsburgh, Pa., is on leave of absence serving as an administrative consultant in Washington, D. C.

Richard Cutts, Jr. (A'29) meter specialist, General Electric Company, Boston, Mass., has been transferred to the meter division of the company's central-station department at West Lynn, Mass.

R. E. Walker (A'41) powerhouse operator, Powerdale Plant, Pacific Power and Light Company, Hood River, Oreg., has become principal radio electrician with the Civil Aeronautics Administration, Nome, Alaska.

S. B. Way (A'03, F'38) president, Wisconsin Electric Power Company, Milwaukee, Wis., has been awarded an honorary degree of doctor of science by Drexel Institute of Technology.

J. L. Kilpatrick (A'09) retired president of the New York Telephone Company, New York, N. Y., has also received an honorary degree of doctor of science from Drexel Institute of Technology.

F. E. Ricketts (A'16) vice-president, Consolidated Gas Electric Light and Power Company of Baltimore (Md.) recently was awarded an honorary degree of doctor of engineering by the University of Maryland.

J. H. Foote (A'18, F'32) supervising engineer, Commonwealth and Southern Corporation, Jackson, Mich., has been elected a member of the executive committee of the American Society for Testing Materials.

W. P. Dobson (A'13, M'19) chief testing engineer, Hydro-Electric Power Commission of Ontario, Toronto, has been elected president of the Dominion Council of Professional Engineers.

OBITUARY • • • •

Rudolf Lorenz Weber (A'16, M'27) Stone and Webster Engineering Corporation, Boston, Mass., died on April 27, 1942. He was born on September 14, 1883, in New York, N. Y., and received the degree of mechanical engineer from Cornell University in 1905. After doing miscellaneous mechanical and electrical work from 1905 to 1908, he became associated with Robert P. Woods, consulting engineer, as electrical construction engineer and in this capacity worked on the construction of the Portales (N. Mex.) Irrigation Project as well as the powerhouse of the Roswell Gas and Electric Company and the Berrendo Irrigated Farms Project, both at Roswell, N. Mex. He became equipment and power engineer for the Wyandotte Construction Company in 1911 and in this position did design and construction work on the Kansas City, Clay County, and St. Joseph Railway. He was employed as resident engineer at the Saxon Falls Hydroelectric Project, Ironwood and Bessemer Railway and Light Company, Inwood, Mich., from 1912 to 1913, when he joined Ford, Bacon, and Davis as construction and designing engineer. In 1914 he was appointed electrical engineer, Board of Control, Kansas City (Mo.) Railways Company, and in 1916 he was made engineer of equipment and power. Since 1924 he had been an engineer in the electrical division, Stone and Webster Engineering Corporation. He played a large part in the design and construction of steam and hydroelectric power stations—throughout the United States and had become prominent for his work on transit facilities and electric railway problems. He served as chairman of the AIEE Kansas City Section, 1923–24. He was also a member of The American Society of Mechanical Engineers, the American Society of Naval Engineers, and the American Transit Association.

Chester Waters Larner (A'12) president, Larner Engineering Company, Philadelphia, Pa., died June 11, 1942. He was born at Elizabeth, N. J., on March 3, 1881, and in 1897 was graduated from Baltimore Polytechnic Institute. In 1897 he joined the Standard Oil Company, Baltimore, Md., and in 1900 he became instructor in mathematics at the University of Chicago (Ill.). He was a structural designer with the New Jersey Bridge Company from 1901 to 1902, when be became designer of hydraulic turbines for the I. P. Morris Company. In 1906 he was employed by the International Steam Pump Company as mechanical engineer and in 1907 he became hydraulic engineer in charge of the hydraulic turbine department for the Wellman-Seaver-Morgan Company, Cleveland, Ohio. He was president of the Larner-Johnson Valve and Engineering Company from 1918 to 1922, when he became president of the Larner Engineering Company. He played a large part in the design of hydraulic machinery for water power plants and with R. E. Johnson was the inventor of the Larner-Johnson valve. He was also a member of The American Society of Mechanical Engineers and the American Society of Civil Engineers.

John Egli (A'26, M'36) assistant superintendent, manufacturing department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., died on May 10, 1942. He was born at Basle, Switzerland, March 4, 1892, and was graduated from the Swiss Federal Polytechnic University. He joined Maffei and Company, Munich, Germany, as a tool maker in 1911 and in 1912 was employed by the Brown Boveri Company, Baden, Switzerland, to work on the erection of electric power plants. Following an interval of study at the Swiss Federal Polytechnic University, he returned to the Brown Boveri Company to do research on mercury-arc rectifiers, and in 1924 he was made erection engineer. In 1925 he became supervising field engineer with the American Brown Boveri Electric Corporation, Camden, N. J., and 1928 became manager of the service and erecting department. When that company was taken over by the Allis-Chalmers company in 1931, he became an assistant superintendent in charge of the manufacture of transformers and mercury-arc rectifiers for the latter organization.

Ralph Waldo Eaton (A'07, M'13) public service engineer, city of Providence, R. I., died on June 1, 1942. He was born on February 13, 1880, at Hill, N. H., and was graduated from Massachusetts Institute of Technology in 1903 with the degree of bachelor of science. In that year he was employed by the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., as engineering apprentice, in 1905 he was transferred to that company's Boston office, and in 1907 he joined the sales department. In 1913 he became electrical engineer with the Connecticut Company, New Haven, and in 1914 he joined the Shore Line Electric Railway Company, Norwich, Conn., as electrical superintendent. In 1918 he became public service engineer for the city of Providence and in this capacity later worked on traffic problems.

George Marshall Cole (A'02) retired manager of the New York State Electric and Gas Corporation, Plattsburg, N. Y., died

January 6, 1942. He was born December 31, 1862, at Brockville, Ont. After being in charge of road construction from 1885 to 1889, he went to Plattsburg, N. Y., and in 1890 established the Plattsburg Light, Heat, and Power Company and became its manager. In 1896 he founded the Plattsburg Traction Company of which he was manager for a number of years. He continued to manage the Plattsburg Light, Heat, and Power Company and in 1924 when it was taken over by the Associated Company, he remained as head of the local organization, which was later the northern division of the New York State Electric and Gas Corporation. He retired from the managership in 1934.

Clifford Steele Van Dyke (A'11) rate engineer, New York Power and Light Corporation, died on May 8, 1942. He was born at Greenville, Ohio, on January 24, 1876, and was graduated from Ohio State University in 1902. In 1903 he joined the testing department of the General Electric Company and in 1906 he was employed by the Schenectady (N. Y.) Illuminating Company. He became superintendent for the Mohawk Edison Company, Inc., in 1919, and in 1920 he joined the Adirondack Power and Light Corporation as superintendent in the operating department, later becoming engineer. In 1927 he was employed by the New York Power and Light Corporation as rate engineer.

W. R. Hewitt (A'94) president, Rider Hewitt Lumber Company, San Francisco, Calif., died on February 21, 1940. He was born on September 17, 1868, at San Francisco, Calif., and attended Columbia University. In 1894 he became chief of the San Francisco (Calif.) Department of Electricity, and in 1908 he joined the Charles R. McCormick Company, San Francisco, as supervisor. In 1920 he established a lumber business in New York, N. Y., working with the McCormick company. In 1926 he terminated his association with that company and continued his own business until his retirement in 1938.

MEMBERSHIP • •

Recommended for Transfer

The board of examiners, at its meeting on July 23, 1942, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Fellow

Bollinger, H. M., general plant dial system supervisor, Chesapeake and Potomac Telephone Company, Washington, D. C.
Crump, L. L., vice-president and chief engineer, James R. Kearney Corporation, St. Louis, Mo.
Defandorf, R. M., senior physicist, National Bureau of Standards, Washington, D. C.
Smith, H. L., chief engineer, The Louis Allis Company, Milwaukee, Wis.
Sparkes, H. P., manager, meter division sales, Westinghouse Electric and Manufacturing Company, Newark, N. J.
Vinal, G. W., physicist, National Bureau of Standards, Washington, D. C.
Wyman, M. B., manager, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa .

7 to grade of Fellow

To Grade of Member

Beckwith, S., engineer-in-charge, a-c design, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.
Blegen, G. C., associate superintendent, power operation, United States Engineer Office, Bonneville, Oreg.
Chapman, H. H., manager, Westinghouse Electric and Manufacturing Company, Minneapolis, Minn.
Cook, S. S., section engineer, Westinghouse Electric and Manufacturing Company, Sharon, Pa.
Crampton, R. E., appraisal engineer, Gary Heat, Light, and Water Company, Gary, Ind.
Downie, E. G., laboratory electrical engineer, Genera Electric Company, Fort Wayne, Ind.
Dunlap, L. J., syndicate representative, Westinghouse Electric and Manufacturing Company, Chicago, Ill.
Endres, L. M., chief mechanica service division, manager, P.B.A., Washington, D. C.
Fritz, L. J., district plant engineer, Ohio Bell Telephone Company, Dayton, Ohio.
Harris, L. K., electrical engineer, Detroit Edison Company, Detroit, Mich.
Hathaway, C. M., chief engineer, Hathaway Instrument Company, Denver, Colo.
Irwin, E. M., manager, Waugh Laboratories, Pasadena, Calif.
ames, H. C., chief engineer and general manager, North Loup River Public Power and Irrigation District, Arcadia, Nebr.
Kennedy, R. M., major, United States Army, Post Signal Officer, Fort Sam Houston, Tex.
Lewis, J. P., division engineer, Connecticut Power Company, Stamford, Conn.
McEachron, K. B., Jr., supervisor of advanced course, General Electric Company, Schenectady, N. Y.
Miner, R. W., Ohio Bell Telephone Company, Columbus, Ohio.
Nebbia, A. M., division power representative, Public Service Electric and Gas Company, Hackensack, N. J.
Peterson, E. F., head of electrical engineering department, University of Santa Clara, Santa Clara, Calif.
Plant, E. C., assistant engineer, Public Service Electric and Gas Company, Newark, N. J.
Ricker, E. A., assistant engineer, Hydroelectric Power Commission of Ontario, Toronto, Ont.
Ross, M. D., section engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Sawle, R. T., design engineer, English Electric Company of Canada, Ltd., St. Catharines, Ontario, Canada.
Snow, L. D., supervisor of relays and voltage regulation, Puget Sound Power and Light Company, Seattle, Wash.
Ward, R. D., laboratory technician, Ward Leonard Electric Company, Mt. Vernon, N. Y.

25 to grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Names of applicants in the United States and Canada are arranged by geographical District. If the applicant has applied for direct admission to a grade higher than Associate, the grade follows immediately after the name. Any member objecting to the election of any of these candidates should so inform the national secretary before August 31, 1942, or October 31, 1942, if the applicant resides outside of the United States or Canada.

United States and Canada

1. North Eastern

Miske, F., Eastman Kodak Company, Rochester, N. Y.
Sanderson, F. C., 6 Parson's Lane, Rochester, N. Y.

2. Middle Eastern

Berenhauser, C., Jr., Electrical Engineer, 2422 Euclid Avenue, Cleveland, Ohio.
Daily, C. F. (Associate re-election), American Telephone and Telegraph Company, Cincinnati, Ohio.
Dunn, J. A., Island Creek Coal Company, Holden, West Virginia.
Goolsby, G. N., Westinghouse Electric and Manufacturing Company, Sharon, Pa.
Kruger, S., Westinghouse Electric and Manufacturing Company, Sharon, Pa.
Locke, P. S., Westinghouse Electric and Manufacturing Company, Sharon, Pa.
Madsen, H. C. (Associate re-election), Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.
Mecklenborg, R. H., Jr., Automatic Temperature Control Company, Inc., Philadelphia, Pa.
Mentzer, J. R., Westinghouse Electric and Manufacturing Company, Baltimore, Md.
Myers, H. C. (Associate re-election), Westinghouse Electric and Manufacturing Company, E. Pittsburgh, Pa.
Peterson, A. V., Westinghouse Electric and Manufacturing Company, Sharon, Pa.
Roth, J. A., General Electric Company, Erie, Pa.

3. New York City

Blonsen, J. H., Cole Electric Products Company, Long Island City, N. Y.
Caldwell, O. H. (Member re-election), Caldwell-Clements, Inc., New York, New York.
Heins, H. H., Westinghouse Electric and Manufacturing Company, New York, N. Y.
Isaacs, M., Corps of Engineers, War Department, New York, N. Y.
Jacobus, R. F. (Member re-election), Engineer-Architect, New York, N. Y.
James, F. H., J. G. White Engineering Corporation New York, N. Y.
Kisbany, G. H. (Member), Consolidated Edison Company of New York, Inc., New York, N. Y.
La Mantia, J., Chemical Construction Company, New York, N. Y.
Lewis, R. A., J. G. White Engineering Corporation, New York, N. Y.
Nicholson, G. C. J., Semet Solvay Engineering Company, New York, N. Y.
O'Riordan, P. A. (Member), Newfoundland Base Contractors, New York, N. Y.
Phelps, W. A. (Associate re-election), Bell Telephone Laboratories, Inc., New York, N. Y.
Schreuer, C. L., Gibbs and Cox, Incorporated, New York, N. Y.

4. Southern

Allen, G. W. (Member), United States Maritime Commission, New Orleans, La.
Bohner, C. W. (Member), Tennessee Valley Authority, Knoxville, Tenn.
Lobosco, A. F., U. S. Maritime Commission, New Orleans, La.
McLemore, R. E., Tennessee Valley Authority, Pickwick Dam, Tenn.
Milburn, J. B. (Member), Electric Power Board, Chattanooga, Tenn.
St. Petery, L. B., United States Navy Department, Naval Air Station, Jacksonville, Fla.
Snyder, E. R. (Associate re-election), Tennessee Valley Authority, Knoxville, Tenn.

5. Great Lakes

Baker, M. A., General Electric Company, Fort Wayne, Ind.
Davis, D. W. (Associate re-election), Dean W. Davis and Company, Inc., Chicago, Ill.
Miller, C. G. (Associate re-election), Weston Electrical Instrument Company, Chicago, Ill.
Scheer, A., Sanderson and Porter, Joliet, Ill.
Sullivan, R. S., Indianapolis Power and Light Company, Indianapolis, Ind.
Weigel, F. W., Jr., E. I. du Pont Company, Charleston, Ind.

6. North Central

Marcum, T. E. (Associate re-election), Farm Credit Building, Omaha, Nebraska.

. South West

Eynon, A. W., U. S. Engineer Department, War Department, Tulsa, Oklahoma.
Fischer, D. A., Washington University, St. Louis, Mo.
Hilbert, E. E. (Associate re-election), Wagner Electric Corp., St. Louis, Mo.
Laughlin, L. W., Missouri Electric Power Company, Springfield, Mo.
Ratliff, K., Lower Colorado River Authority, Austin, Texas.

8. Pacific

Beebe, L. H. (Associate re-election), Southern California Edison Company, Ltd., Alhambra, Calif.
Haist, C. T., Jr., Boeing School of Aeronautics, Oakland, Calif.
Knapp, A. A., Elevator Maintenance Company, Ltd., Los Angeles, California.
Martin, F. G. (Associate re-election), Leeds, Hill, Barnard and Jewett, Los Angeles, Calif.

9. North West

Trowbridge, H. M., Westinghouse Electric and Manufacturing Company, Portland, Oregon.

10. Canada

Dillon, E. A., Canadian General Electric Company, Ltd., Peterboro, Ont.
Hardwick, A. P., Canadian General Electric Company, Peterborough, Ont.
Shearer, C. W., 957 Pelissier St., Windsor, Ont.

Total United States and Canada, 54

Elsewhere

Christie, J., A. Reyrolle and Company, Ltd., Hebburn-on-Tyne, England.
Wadeson, H. L. (Member), City of York Electricity Department, York, England.

Total, elsewhere, 2

OF CURRENT INTEREST

Army Specialist Corps Provides Means of Securing Technical Men for Services

Pointing out the necessity for priorities in brain power as well as in war materials, Brigadier General William O. Hotchkiss, deputy director, Army Specialist Corps, spoke at the annual meeting of the Society for the Promotion of Engineering Education on June 27, 1942, at New York, N. Y., on the formation and function of the Army Specialist Corps. The text of his address follows:

Recently I heard an experienced Army officer state emphatically that our most valuable asset is man power. I agreed with him heartily and added that that part of our man power with highly trained brain power was the most precious of all. We have read frequently of "bottlenecks" in the supply of steel plates for ships, or of engines for airplanes, or of tanks and guns. We have rarely seen in print the real bottleneck, which was that there were not enough men with the proper quantity and quality of brain power working on the problem in time. Every instance of "too little and too late" in ships, in supplies, and in munitions can be stated in terms of too little and too late application of trained brains to the problem.

For many lines of activity necessary for war purposes, there are not in existence a sufficient number of properly trained and skilled individuals. We have priorities on most kinds of materials, but we have not yet heard of any really adequate plan for priorities for our trained brain power. We have not yet developed a workable scheme to stop this waste. The matter is complex and involved, but nevertheless we must stop, in every way we can, the waste of the most precious part of our most valuable asset—trained man power. I know of no more effective way to aid our enemies, the Germans and the Japanese, than to permit in any way such waste. The man who sees it and does not strive to prevent it is guilty of some degree of "contributory treason" whether that be recognized as a crime or not.

In the conduct of war there is a wide diversity of occupations as there is in civil life, plus a wide range of duties that are not present in civil life. All these activities have a single aim and objective—the successful engagement of the enemy in combat. Everything is pointed toward the day when we go into the fight and win. To accomplish this objective all the preparatory duties must be well done. But no matter how perfectly the preparatory duties are done, the battle will not assuredly be won unless the officers in command can operate our troops better than the enemy officers operate theirs, other things being equal. Obviously the highest professional military skill is necessary for this. Someone has said that a good general is as valuable as an extra army. I think I should state it by paraphrasing the familiar old definition of an engineer, a good general is one who can do with one division the things an ordinary general can do with two.

One of the serious bottlenecks in this war is our supply of officers with professional military training and experience. We cannot afford to waste a single one on duties of any other nature. Always in peacetime we have maintained an army of relatively insignificant numbers. When war comes upon us it is not only a scramble to build the ships and planes and tanks and guns needed, it is a scramble to give anything like adequate professional military training to the great numbers of new officers required by the rapid expansion of the army. To waste this particularly valuable trained skill in any way is again in some degree contributory treason. There is no more effective way to help our enemies.

The transition from an army of 150,000 officers and men, which we had just a few years ago, to an army numbered in millions is really a catastrophe. It upsets everything both in personal lives and in business affairs. In a modern war few persons escape its effects. War is no longer the affair of armies; it is the affair of the whole populations of nations. Every man, woman, and child; every pound of steel, aluminum, and tin is a factor in this transition to total war and is affected by it. Every energy, every material, every mental resource we have must be used with the greatest possible speed and with the utmost practical efficiency if we are to be sure of winning this war.

ADJUNCTS TO MILITARY ACTIVITY

The highest function of a military officer is the effective use of his knowledge of strategy and the use of troops and equipment in contact with the enemy. There are multitudinous other functions which are vital adjuncts to these professional military functions. These adjunct functions, in many instances, can be performed satisfactorily by men who have gained the proper experience in their civil occupations. An army is like a great city. Its men must be housed and clothed. They must be fed and provided with necessary utilities—heat, water, light—and sanitary and hospital facilities. They require huge transportation facilities that must operate without fail under difficult and dangerous conditions. They require innumerable repair-shop units to keep their equipment in good operating condition. Roads and railroads must be built and bridges repaired or erected with great speed. All the vast quantities of supplies of clothing, food, shelter, vehicles, arms, tanks, planes, and munitions, must be contracted for, received and warehoused, paid for, shipped by rail, truck, airplane and ship, and shipped again from the unloading port by rail, truck, or airplane. The Army must be paid. A vast accounting job must be performed.

These adjunct duties are very closely parallel to the duties that must be performed in civil life. They can be performed by men who are not professional military men. Capable engineers and businessmen of many different kinds can be used to carry on much of this work, *but they must do it as officers under military command and with military responsibility, not as civilian employees who can quit the job whenever they desire.*

SPECIALIST CORPS FORMED

With such considerations in mind, General George C. Marshall, Chief of Staff, suggested to the Secretary of War the establishment of the Army Specialist Corps. One of the chief objectives was to enable our Army to make the most efficient use possible of the professional military training and talent available.

An erroneous impression has gained credence that only men who are beyond military age, or who are physically disqualified for military service will be appointed as officers in the Army Specialist Corps. Such is not the case. This is only one of the purposes of the establishment of the corps. A more important purpose is to secure officers who, though they lack the experience and training to command troops, can perform vitally important noncombatant military services along the lines of their civilian business and technical experience. It is very likely that thousands of Army Specialist Corps officers will serve with active units of the fighting forces in the air and on the ground. They can aid in transporting supplies and munitions. They can aid in operating the new technical equipment for air operations. They can carry on business and financial duties. They will help conduct the multifarious business of feeding, clothing, housing, equipping, and supplying the armed forces. They will aid in repairing damaged equipment and in many activities that will use fully the knowledge of engineering science, business, and financial matters they acquired as civilians. Many of these men will be of military age and most of them serving with combat units must be as physically fit as troop officers.

In addition to officers of military age and physical fitness, the Army Specialist Corps will appoint many officers from the group of overage and physically disqualified men. Men who for these reasons cannot

perform arduous work can be used for work similar in physical requirements to what they are now doing as civilians. In these cases the age and physical condition demanded will be only that necessary for the less arduous work they will be called on to do. In the selection of such officers, emphasis will be placed on their having the mental ability necessary for the job rather than on their physical condition.

DIVERSITY OF SERVICES

Quite naturally the greatest use for Army Specialist Corps officers is likely to be in the Services of Supply. This is a great procurement, transportation, and technical group of activities in which men qualified by civilian experience can most quickly and readily be put to work. Procurement objectives for many of the services have already been authorized, under which the definite requisitions for the appointment of Army Specialist Corps officers are now being prepared. As an illustration of the diversity of occupations to be served, the following partial list is given:

Transportation Division	Statistical Service
Corps of Engineers	Special Service
Signal Corps	General Depots Division
Quartermaster Corps	Provost Marshal General
Chemical Warfare Service	Judge Advocate General
Ordnance Department	Public Relations
Post Exchange Services	Military Intelligence

In addition to serving the organizations in the Services of Supply, Army Specialist Corps officers will be of use in the Ground Forces and in the Air Forces. They can serve as special service officers, supply officers, executive officers, engineer officers, research officers, statisticians, quartermaster officers, personnel officers, ordnance officers, public relations officers, communication officers, post exchange officers, finance and budget officers, and in many other fields. Many technical positions in motorized and air units can be filled by Army Specialist Corps appointees.

PURPOSES

Out of the preceding statements it may be well to summarize the main purposes of the Army Specialist Corps. One of the principal functions is to find, appoint, and assign to the requisitioning branch, men properly qualified by civilian experience to perform noncombatant military duties that would otherwise have to be performed by professional military officers of the Army of the United States. A second principal function is to help in the more complete use of man power, by using the services of men disqualified for arduous military duty by reason of age or partial physical disability. Many of these disqualified men are daily performing in their civil occupations the same kind of duty that the Army needs. In appointing such officers the physical qualification required is that they can do the job for which they are intended. Brains and experience are emphasized, and physical vigor is required only sufficient for the performance of the duties.

QUALIFICATIONS

The kind of men wanted for officers for the Army Specialist Corps is obvious. Men distinctly of officer quality are needed. They must be men of unquestioned loyalty, and integrity, of education sufficient for the job, of good teamwork capacity. They must have had experience sufficient to enable them to handle the particular job they are appointed to fill. For service in continental United States, only commissioned officers will at present be appointed. For service overseas, both commissioned and noncommissioned officers will be appointed.

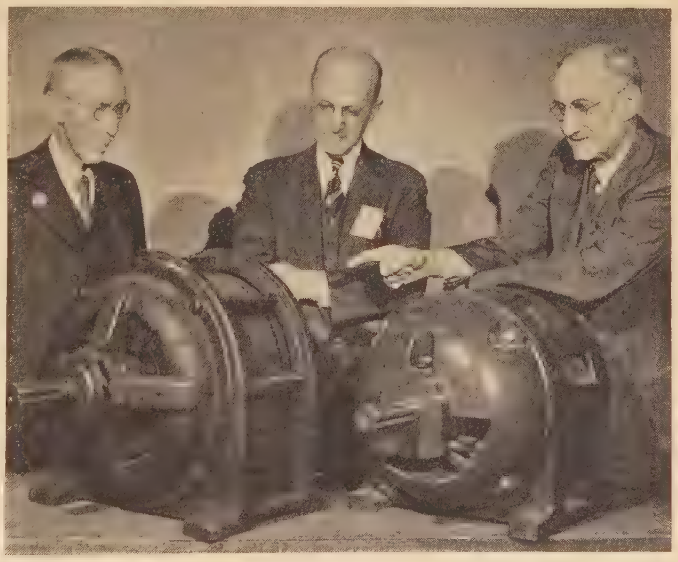
Candidates for officers in the Army Specialist Corps will be sought widely throughout the nation. The Adjutant General's office and the Army Specialist Corps are co-operating in establishing offices in many principal cities to secure officers for both the Army of the United States and this corps. Corps area headquarters of the Army Specialist Corps will be in close co-operation and co-ordination with these offices. These offices will have lists of job specifications for the kind of positions to be filled. Through informed local sources they will seek men with the proper qualifications who are willing to offer their services to the United States. These procurement offices will be staffed jointly by officers of the Army of the United States and the Army Specialist Corps. It is believed that through these offices men of the finest quality can be brought into the service.

In addition to the men secured by these offices, the corps has access to the questionnaires (applications) now filed in the Adjutant General's Office, the Civil Service Commission, in the National Roster of Scientific and Specialized Personnel (see *EE, Aug. '41, p. 413–14*), and many other sources. When these fail to provide a sufficient number of properly qualified officers, the Army Specialist Corps is authorized to train men to fill the needs.

It is in this last group that it will be particularly valuable to have the complete co-operation of the engineering colleges in the United States. The Army and the Navy have jointly asked that graduates in electrical engineering during the last ten years be counted. They have failed to find in that group a sufficient number of men to train in the ultrahigh-frequency courses which they and the colleges are giving. Apparently it is going to be necessary to lower the sights to secure the numbers that must be trained. In all probability, it will be necessary to ask colleges to look through their records and circularize *all* engineering graduates of the last ten years, and also the students who dropped out before completing their work, men who completed only enough of their courses to have a background of physics and mathematics sufficient to warrant their being given refresher courses followed by the special courses needed to supply the current demand. Plans are now being formulated to ask the co-operation of colleges in this important project.

I want to emphasize here that many engineers under 30 years of age who are in Selective Service Class IV-F will be urgently needed for the Army Specialist Corps. Present plans are that such of these men as are selected for training will be commissioned as officers, some in the Army of the United States and others in the Army Specialist Corps. They will then be assigned for training to the various engineering schools and to the schools maintained by the Signal Corps in accordance with their qualifications and the needs of the service. It is hoped that the organization and management of the courses may be handled by the United States Office of Education under the National Advisory Committee for Engineering, Science, and Management Defense Training as their courses now are

Progress in Induction Motors Demonstrated



An induction motor rated 15 horsepower, made by the General Electric Company, Schenectady, N. Y., nearly 40 years ago, is compared with one of the company's 1942 models, rated 25 horsepower. M.H. Wells (A'12) (right) designing engineer, General Electric induction-motor-engineering department, demonstrates the changes to W. J. Foster (F'16) (left), retired General Electric engineer, and C. A. Adams (F'13) (center), consulting engineer, Edward G. Budd Manufacturing Company, Philadelphia, Pa.

being given. In this way the existing facilities will be used most efficiently and duplication of teaching personnel, equipment, and expense eliminated.

Men eligible for appointment in the Army Specialist Corps are limited by a recent order of the Secretary of War. This provides that officers may not be commissioned in the corps who are:

a. In the 20–30 age group unless in class IV-F, "permanently physically disqualified for general military service"

b. In the 30–45 age group if in class I-A of the Selective Service

c. Deferred from induction for occupational reasons unless the Selective Service agrees that they may be taken into the Army Specialist Corps

Exceptions may be made in cases where the candidate has qualifications specially needed. In this connection it is well to remember that regulations and orders may be altered from time to time as conditions require. It is not improbable that, for the urgent needs of the Signal Corps, restriction *a* in the preceding paragraph may have to be modified to make men of the 20–30 age group in Selective Service classes I-B and III-A eligible for appointment in the Corps.

The Army Specialist Corps does not compete with the Selective Service. Men deferred for occupational reasons are not eligible. It is just as necessary to have these men producing war materials as it is to have men in the combat units to use them. Officers appointed to the corps are not thereby taken out of the jurisdiction of the Selective Service according to law. They may be recalled by their draft boards and inducted. But, of course, it is unlikely that corps officers serving overseas with troops will be brought home for induction. Overseas corps officers should be credited to the quota of their draft boards the same as men in the Army. While this is not now possible, it may become so as the needs become more apparent. Furthermore, since no Army Specialist Corps officers will be appointed from class I-A, it is improbable that many such officers will be called by their draft boards.

PROCEDURE FOR APPOINTMENT

As a matter of interest and information, the procedure necessary for appointment of officers in the Army Specialist Corps is set down here in chronological order. It is practically the same as for officers in the Army of the United States.

1. The Arm or Service needing Army Specialist Corps officers files an approved "procurement objective," which is its estimate of the total number of officers that it needs to have appointed

2. Under this it files requisitions stating the kinds of jobs to be done, the various ranks desired, when the officers will be needed, and where and to whom they are to report

3. Requisitions are distributed to the joint procurement offices throughout the United States, and search is also made in the files of the Adjutant General's Office and elsewhere for qualified men

4. Questionnaires (Form 0850) that have been filed with the Army Specialist Corps by applicants are studied, and compared, and records of suitable candidates are submitted to the requisitioning agency for their final approval, after personal interviews with the candidates if the agency so wishes

5. After this selection, the files are sent to the War Department Personnel Board which acts for the Secretary of War in approval or disapproval of the appointment

6. On return of the files of approved candidates, the files are sent to the Adjutant General's Office for issuance of the appointment, for securing the oath of office, and for issuance of Orders as to when and where the appointee is to report

7. Appointment of officers of the rank of major and above must go through a procedure in addition to those listed in item 6. After approval by the War Department Personnel Board, these officers' names must go to the Secretary of War and to the President who must nominate them to the Senate for its approval, which must be forthcoming before the commission and orders can be issued

The Army Specialist Corps will not maintain any [illegible]ating force other than its headquarters and field procurement staff. All other officers appointed will be assigned immediately to the Arm or Service that requisitioned them. Thereafter they will be under the orders of that branch. Judging from the inquiries received, there is a general misconception of this matter. Many persons seem to think that the Army Specialist Corps will operate groups of specialists under its own command to serve the armed forces in special technical and scientific fields. Such is not the case. All activities of Specialist Corps officers other than its own administrative staff will be directly under the command of the various branches of the Army to which they are assigned.

OPPORTUNITY FOR SERVICE

From the picture given of the functions of the Army Specialist Corps, it should be obvious that the corps will afford an opportunity for service to many fine, loyal, patriotic citizens who have hitherto been barred for various reasons. Some have obligations to dependents which could not be met if they volunteered. This corps will provide an opportunity for many such to receive a commission which will enable them to care for these obligations. Others denied commissions in the regular army by reason of age or disability will be usable by the corps. Many in all these groups will find in the corps a very welcome opportunity for them to render the service their patriotism is seeking. The corps will be composed of men of outstanding ability and character. Every man in it will be serving because of his patriotic desire to do his bit for the United States in its time of need.

Power Companies' Stocks to Be Used in New Extensions

The War Production Board has notified electrical utilities that it has worked out plans for using materials in excess stocks of utilities in making electric extensions to housing projects. Henceforth the WPB will not grant authority for the purchase of such material in the open market for use in extensions to housing projects. All such material must come from excess stocks now on hand. These measures were taken because of the shortage of critical materials, especially copper.

As a part of this plan, the WPB power branch has received from electrical utilities reports on their excess stocks of wire and other materials. It is preparing a catalogue of such stocks—copper wire, distribution transformers, and meters—which will be furnished to all electrical utiliti[illegible]

When a utility wishes to ma[illegible]sion [illegible] more than 250 feet [illegible] make application to the WP[illegible] Order *P*-46 requires WPB approval for extensions in excess of 250 feet. If the WPB approves the application, the utility will be authorized to use materials from its own stock or to acquire them from another utility company.

In addition, a new WPB requirement stipulates that no new housing project be started prior to obtaining approval for extensions of utility services. These services include not only electric service, but also gas and water. Utilities are asked to prepare promptly their applications for extensions for new housing projects.

In order to reduce the quantity of critical materials used in making electric, gas, and water extensions to housing projects, the WPB power branch has reduced the allowable weights of materials and distances for such extensions. For example, only 30 pounds of copper wire may be used per dwelling unit instead of the previous 60, and the distribution transformer capacity per unit may be only 200 watts instead of 300.

The new standards apply to houses on which construction began after April 22, 1942.

New Construction Regulations to Conserve Materials

In a move to make all possible material and effort available for immediate war production, top officials of the War Production Board and the War and Navy Departments have established broad principles governing all wartime construction which will bring such building under more rigid conservation control. The program means that no new plants will be built unless they are absolutely essential and can meet seven newly established criteria. This applies not only to direct war plants but to all other construction, both publicly and privately financed.

One of the main reasons for the new policy is that all critical materials are needed for war production now, and no materials can be spared for building new facilities except when they are absolutely necessary. The policy means simply that in the light of existing shortages, it is necessary to put materials and effort into airplanes, ships, tanks, and guns now, rather than putting them into plants which would not produce fighting weapons until a much later date. In addition, it is necessary to make the fullest possible use of all existing plant facilities that can be used or can be converted to use.

The principles were outlined in a directive, effective immediately, signed by Donald M. Nelson, chairman of the War Production Board, William H. Harrison

(F'31), director of production, Henry L. Stimson, Secretary of War and Frank Knox, Secretary of the Navy.

The seven criteria that must be met before any project will be approved for constru[illegible]y:

1. It is esse[illegible]he war effort.

2. Postponement of [illegible]ruction would be detrimental to the war effort.

3. It is not practical to rent or convert existing facilities for the purpose.

4. The construction will not result in duplication or unnecessary expansion of existing plants or facilities now under construction or about to be constructed.

5. All possible economies have been made in the project, resulting in deletion of all non-essential items and parts.

6. The projects have been designed of the simplest type, just sufficient to meet the minimum requirements.

7. Sufficient labor, public utilities, transportation, raw materials, equipment, and the like are available to build and operate the plant. The manufactured product can be used at once or stored until needed.

BUREAU OF CONSTRUCTION MOVES

The bureau of construction, recently established to co-ordinate all construction functions of the War Production Board, has moved to New York and opened headquarters in the Empire State Building.

Except for a small office staff that remained in Washington for liaison work, the entire organization under William V. Kahler, chief of the bureau, is affected by the change. Thomas L. Peyton, assistant to the chief, is in charge of the Washington office.

Substitute Materials in Electric Lamps

Use of critical materials in the manufacture of electric lamps is being curtailed without curtailing the production of the lamps themselves, by an amendment to Limitation Order *L*-28 recently issued by the War Production Board. This is made possible through the use of substitutes that will not affect the efficiency of the lamps. The base, formerly made of solid brass, is being made of steel plated with brass. Lamp leads, formerly made of a 50-50 combination of nickel and copper, are being made of iron wire plated with nickel and copper. Filament supports, formerly made of nickel and molybdenum, are being made of iron wire plated with nickel. The filament itself will continue to be made of tungsten, since no satisfactory substitute has been found. The plating process will require only about a tenth as much of the critical metals as was used before. The substitution provisions of the order went into effect July 1.

Not only will there not be a curtailment in the production of lamps, but the amendment permits greater production than in 1940. During the three-month period beginning July 1, and for each three-month period thereafter, a manufacturer is permitted to produce bases for incandescent and fluorescent lamps at a rate of 125 per cent of his production in 1940. In addition, he may exceed even that rate of production in one three-month period if he will reduce his production during the succeeding three months accordingly.

The amendment also prohibits the manufacture of Christmas-tree, advertising, and decorative or display lights. The original order reduced such production by 50 per cent. The amendment eliminates such production entirely, effective June 1.

The substitute provisions will not apply until September 6, 1942, to orders placed by or for the Army, Navy, or United States Maritime Commission. It has been estimated that the order will result in monthly savings of the following c[illegible]l material, based on 1940 consumption: 1,000,000 pounds of brass, 40,000 pounds of copper, and 30,000 pounds of nickel.

Engineer Corps Needs Maps

Maps and aerial photographs of all areas outside the continental United States are wanted by the United States Army Corps of Engineers. Individuals and companies possessing such maps or photographs have been requested to notify the nearest office of the Foreign Map section of the Corps of Engineers. Copies will be made and the originals returned to the owners, it was announced. The offices to be contacted are:

New York Unit, Room 820, 1270 Sixth Avenue, New York, N. Y., Circle 6-1484.

New Orleans Unit, Room 900-A, Maritime Building, New Orleans, La., Magnolia 4006.

San Francisco Unit, Room 546, 74 New Montgomery Street, San Francisco, Calif., Exbrook 2009.

Intelligence Branch, Office, Chief of Engineers, United States Army, Room 3168, New War Department Building, Washington, D. C., Republic 6700, extension 5234-6409.

FPC Loans Staff to WPB

Approximately half of the national-defense staff of the Federal Power Commission has been loaned to the Power Branch of the War Production Board for the duration of the war, according to recent announcement. The Power Branch will have jurisdiction over such wartime power matters as supply, requirements, and rationing. Full authority over plant protection is retained by the FPC, as are regulatory powers.

WPB Issues Booklet on Plant Efficiency. The division of information of the War Production Board has published a booklet called "Plant Efficiency—Ideas and Suggestions on Increasing Efficiency in Smaller Plants," designed primarily for smaller war plants or for plants which are just getting into war production and which might be able to increase production by a study of efficiency procedures. The booklet includes chapters on lighting; cutting down of accidents; adapting old machines to new jobs; maintenance and repair; longer life for cutting tools; getting the most out of machine tools; production lines geared for war; meeting government standards; training workers quickly; swing shifts; keeping track of orders, production, and materials; plant protection; pooling facilities; priorities; and getting into war work. Copies may be obtained upon request from regional and local offices of the WPB located in 120 cities; from local offices of the division of information, office for emergency management; or by writing to the division of information, office for emergency management, Washington, D. C.

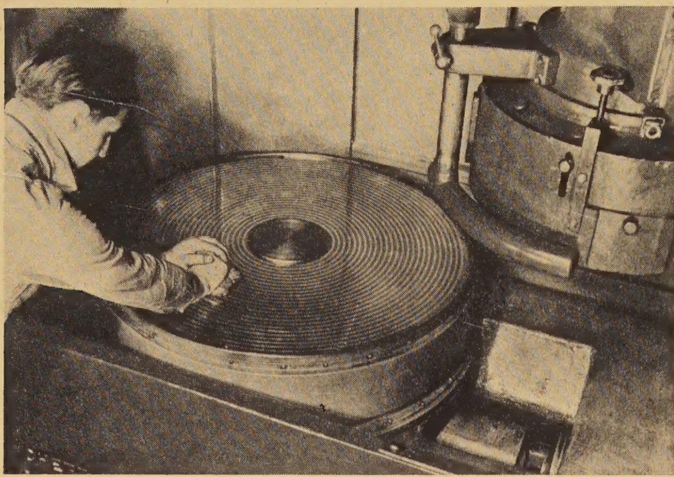
OEM Functions Described in Booklet. A publication entitled "OEM Handbook," describing the functions and organization of the war agencies within the Office for Emergency Management, was issued recently. The 72-page booklet describes in detail the organization of the War Production Board, the Office of Price Administration, and the other constituent agencies of the OEM. Personnel is listed in most cases down to the branch level in each agency. Included are organization charts of the WPB and the Bureau of Industry Branches of the WPB Division of Industry Operations, as well as a chart showing the relationship of the various Federal war agencies. Copies of the booklet are available in room 1501, New Social Security Building, and from the Superintendent of Documents, Washington, D. C., as well as from OEM field offices.

Planning Board Issues Pamphlet on Cities. A 22-page pamphlet called "Better Cities" has recently been issued by the National Resources Planning Board, as the third in its series on postwar planning. The first two were "After Defense—What?" and "After the War—Full Employment." The pamphlet on city planning, prepared by Charles S. Ascher, consultant to the board and former executive director of the National Association of Housing Officials, points out that the end of the war will offer the people of the United States an opportunity to rebuild their cities and suggests some concepts which should underlie such a rebuilding program. Planning on a broad scale—"by the square mile, not the square block," study of new methods, and more effective co-ordination of public and private efforts are among the concepts emphasized.

INDUSTRY . . . . .

Coffin Award to San Diego Company. The San Diego (Calif.) Gas and Electric Company has been presented the Charles A. Coffin award for 1941 in recognition of the company's outstanding record of performance in contributing to the development of electric light and power for public and industrial purposes. Presentation of the gold medal was made at a recent meeting of the Edison Electric Institute. The

Magnetic Table for Grinding Machine



Production of turbine parts at the Westinghouse Electric and Manufacturing Company's new merchant marine works is speeded by use of a grinding machine with a magnetic table that holds parts in place without requiring adjustment of clamps and enables simultaneous finishing of several parts.

award also includes $1,000 for the employees' welfare organization. The Charles A. Coffin Foundation, which makes the award, was established by the General Electric Company in 1922 in honor of its founder and first president.

Arbitration Group Elects Wilson. Charles E. Wilson, president of the General Electric Company, Schenectady, N. Y., has recently been elected a member of the board of directors of the American Arbitration Association. The Association, a nonprofit organization with headquarters in New York, N. Y., provides voluntary arbitration facilities to industry, through a panel of arbitrators consisting of some 8,000 educators, professional men, and business men located in cities throughout the United States, Canada, and Central and South American countries.

LIBRARY

Orders Increasing for Photostat and Microfilm Copies

The photostatic and microfilm processes for reproducing documents are attracting steadily growing attention, and the experience of the Engineering Societies Library indicates that more and more members of the societies are making use of these processes. Orders for such copies are 25 per cent greater this year than last. Not only requests for single articles one or two pages long, but orders calling for hundreds of prints come in. Many establishments build up files of all articles relating to their work instead of collecting sets of periodicals. In this way much space is saved by the elimination of irrelevant material.

Both methods of copying have their advantages. Photostats resemble ordinary documents. They can be filed in the same way, in letter files or loose-leaf binders. Several can be spread out and consulted simultaneously. Other documents can be interfiled with them.

Microfilm copies are cheaper and when long articles or whole books are to be copied the saving is large. To use them, some sort of projection apparatus or reading machine is necessary. These machines are as yet not common office equipment. Good ones cost about what typewriters do. Film is not as easy to store and handle as photostats are.

Up to now, most members have seemed to prefer photostat copies, but the Library is ready at all times to supply either photostats or microfilms, as desired.

JOINT ACTIVITIES

Industrial Lighting Standard Issued. An important and timely contribution is represented in the new American Standard, "American Recommended Practice of Industrial Lighting," a report recently completed under the sponsorship of the Illuminating Engineering Society through the collaboration of a Sectional Committee organized under the rules and procedures of the American Standards Association. This new code supersedes and replaces an earlier work entitled "Code of Lighting: Factories, Mills, and Other Work Places," which was adopted August 18, 1930, as an American Standard. Text of the new code was published in the May 1942 issue of *Illuminating Engineering* and thus distributed throughout the membership of the Illuminating Engineering Society.

Standard for Dry Cells and Batteries. A new edition of the American Standard Specifications for Dry Cells and Batteries, *C*18-1941, has been issued by the American Standards Association. In addition to types of batteries covered in the last edition of this Standard, the new edition includes best standard practice in miniature cells and batteries for portable radios, radio sondes, and newer types of vacuum-tube hearing-aid devices. Recommendations for further development of hearing-aid batteries are included. Copies of the Standard may be obtained from ASA headquarters, 29 West 39th Street, New York, N. Y., at ten cents each. Among the members of the ASA Sectional Committee which prepared the new edition are:

G. W. Vinal (M'19), National Bureau of Standards, *chairman;* W. B. Kouwenhoven (F'34), Johns Hopkins University, AIEE representative and member at large; H. C. Koenig (M'30), Electrical Testing Laboratories, Association of Edison Illuminating Companies representative; H. M. Turner (M'20), Yale University, Institute of Radio Engineers representative; E. B. Wheeler (M'21), Bell Telephone Laboratories, ASA Telephone Group representative.

OTHER SOCIETIES

Industrial Research Institute Elects Officers

At the fourth annual meeting of the Industrial Research Institute held in Cleveland, Ohio, May 22–23, 1942, more than 50 industrial executives and research directors participated in round-table discussions on the adjustment of research programs and personnel to meet war conditions. The program also featured inspection visits to the new Thompson Aircraft Products Company plant at Euclid, Ohio, and the General Electric Institute, Nela Park.

New officers of the Industrial Research Institute for the ensuing year were announced as follows:

H. S. Benson, administrative engineer, research division, United Shoe Machinery Corporation, Beverly, Mass., *chairman* of the executive committee; W. R. Hainsworth, vice-president, Servel, Inc., New York, N. Y., *vice-chairman;* P. W. Pillsbury, president, Pillsbury Flour Mills Company, Minneapolis, Minn., and

Future Meetings of Other Societies

American Institute of Chemical Engineers. 35th annual meeting, November 16–18, 1942, Cincinnati, Ohio.

American Institute of Mining and Metallurgical Engineers. Regional meeting, October 12–17, 1942, Los Angeles, Calif.; joint meeting, coal division, AIME, and fuel division, ASME, October 1–2, 1942, St. Louis, Mo.

American Physical Society. 251st meeting, November 27–28, 1942, Chicago, Ill.

American Society of Mechanical Engineers. Fall meeting, October 12–14, 1942, Rochester, N. Y.

American Society of Tool Engineers. Semiannual meeting, October 16–17, 1942, Springfield, Mass.

American Welding Society. 23d annual meeting, October 12–15, 1942, Detroit, Mich.

Association of Iron and Steel Engineers. Annual convention, September 22–24, 1942, Pittsburgh, Pa.

Illuminating Engineering Society. Annual convention, September 21–22, 1942, St. Louis, Mo.

National Safety Council. 31st national safety congress and exposition, October 6–8, 1942, Chicago, Ill.

Harold K. Work, manager of research and development, Jones and Laughlin Steel Corporation, Pittsburgh, Pa., members of the executive committee elected for three-year terms. Other members of the committee are: F. W. Blair, chemical director, Procter and Gamble Company, Ivorydale, Ohio; C. P. Haskins, president, Haskins Laboratories, New York, N. Y.; Maurice Holland (M'30) division of engineering and industrial research, National Research Council, New York, N. Y.; and R. C. Newton, vice-president, Swift and Company, Chicago, Ill.

ASTM Awards Medal; Elects Officers

At the 45th annual meeting of the American Society for Testing Materials held on June 24, 1942, at Atlantic City, N. J., the Charles B. Dudley Medal, established to commemorate the society's first president, was awarded jointly to F. C. Todd (A'27) assistant professor, mineral industries experiment station and A. W. Gauger, director mineral industries research, both of Pennsylvania State College, for their paper, "Studies on Measurement of Water Vapor in Gases," which was presented at the 1941 ASTM annual meeting. The award is given for a technical paper which is considered to be of outstanding merit and which constitutes a contribution of original research.

ASTM officers for 1942–43 as announced at the meeting are as follows:

President: H. J. Ball, professor of textile engineering, Lowell (Mass.) Textile Institute.

Vice-president: P. H. Bates, chief, clay and silicate products division, National Bureau of Standards, Washington, D. C.

Members of the executive committee: R. P. Anderson, secretary, division of refining, American Petroleum Institute, New York, N. Y.; M. H. Bigelow, director of technical service, Plaskon Company, Inc., Toledo, Ohio; J. H. Foote (A'18, F'32) supervising engineer, Commonwealth and Southern Corporation, Jackson, Mich.; Alexander Foster, Jr., vice-president, Warner Company, Philadelphia, Pa.; and L. H. Fry, railway engineer, Edgewater Steel Company, Pittsburgh, Pa.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers, publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

Laplacian Transform Analysis

To the Editor:

I believe that the closing sentence in Millman's article in the April 1941 issue of *Electrical Engineering* ("Laplacian Transform Analysis of Circuits With Linear Lumped Parameters," by Jacob Millman, pages 197–205) cannot be substantiated when the circuit consists of a relatively small number of branches having lumped constants, such for example as his illustrative circuit of Figure 3. The classical method has far greater possibilities than this article indicates. In fact, I have found from a detailed study of a number of typical conditions involving second- and fourth-order equations that, on the average, *more* arithmetical computation is necessary when the transform method is used than when the classical method is used effectively. A number of my associates believe that this information is of considerable interest and warrants publication.

WALDO V. LYON

(Professor of electrical engineering, Massachusetts Institute of Technology, Cambridge)

Distribution Systems in Wartime

To the Editor:

J. A. Krug, chief of the power division of the War Production Board, in his address before the Institute on January 26, 1942 ("Mobilizing Kilowatts for War," *EE, Mar. '41, p. 126–31*), referred to the tremendous demands that would come on the utility systems this year and next for a maximum "all out" war effort. Most of our efforts in planning for power supply to meet the war load have been centered largely on the provision of adequate generating capacity, of transmission lines, and interconnections between systems. It is therefore very pertinent that the attention of the electrical engineers of the country now be directed to the effect of the war on distribution systems and in planning and providing such measures and facilities as will meet the increased demands upon such systems.

Because of the flexibility of our power-supply systems, from generators, transmission systems, substations, to distribution systems, and through the use of reserves and interconnections with neighboring utilities and with private industrial generating plants, much additional load can be carried with the present facilities for an "all out" war effort. However, with all facilities used to their maximum, in many areas the loads will be greater than present facilities can handle and rationing of power in these areas will become necessary.

The curtailment of sales promotion and restrictions in the sale of new appliances through diversion of these industries to the manufacture of war materials undoubtedly will help to relieve the utilities from making further extensions of their distribution systems except to supply war industries, national-defense housing projects, and other essential services.

The recent order of the War Production Board limiting the extensions to meet war loads, and limiting new services to the areas served from existing lines by utility systems, will help still further to relieve the loads on distribution systems.

Many distribution systems which have been well designed with adequate copper in primaries and secondaries and adequate feeder cable can carry additional energy loads without much additional investment other than the distribution transformers. It has been estimated that on some systems load factors can be increased so that as much as 40 per cent additional energy can be furnished over existing systems without much increase in peaks. Those systems, however, in which copper was skimped in the original design and which have been constructed more or less on a "shoestring" basis, will find themselves in great difficulty. The problem may be met on these by permitting higher voltage drops, that is, poorer regulation, by installing feeder voltage regulators where none are now used; or, as has been pointed out in one of the papers in the symposium on distribution systems in wartime (AIEE *Transactions*, volume 61, 1942, March section, pages 105–26), by installing boosters or shunt capacitors, or by reinforcing existing feeders, which of course will require more copper, a critical and vital war material at the present time.

These wartime loads through longer hours' use bring a tremendous increase in daily, monthly, and annual load factors. Some feeders now are operating with load factors higher than the system load factor. With higher load factors, diversity between feeders and loads is reduced and tends to disappear. As feeders and transformers have to carry these sustained loads, it becomes all the more important to keep a careful watch on cable and transformer loads and temperatures, especially in view of the difficulty of maintaining a suitable stock of spares or of getting replacements except in extreme emergencies such as breakdown or the burnout of equipment. We will have to take these chances, however, and run the risk of furnishing less reliable service in order to assure adequate power supply to all the war industries and essential uses.

Before the outbreak of the war in Europe, the British Government, in co-operation with the utilities, provided stocks of breakers and other switching equipment, transformers, and wire and cable at suitable points. Experience has demonstrated that these proved very useful in restoring service quickly after air raids. Our problem in the United States is somewhat different, however, as many of our systems are as large as the British Grid, are more extensive, and cover more territory. Then again, we may not be subjected to the same danger from air raids except along our east and west coasts.

After the invasion of Norway, Holland, Belgium, and France in the spring of 1940, it became apparent that emergency measures must be adopted to prepare the power systems of the United States to meet the

threat of war. On June 14, 1940, the President directed the Federal Power Commission to take the necessary steps to assure an adequate power supply to all points where most needed for national defense.

In carrying out this directive of the President, conferences were held with both public and privately owned utilities, with manufacturers of equipment—steam turbine generators, boilers, water wheels, water-wheel generators, oil circuit breakers, transformers, insulators, and distribution equipment, and plans developed for meeting the war loads and assuring power supply to vital national-defense industries and for protection of electric-utility properties.

As a result of these conferences, some utilities proceeded at once to order additional stocks of standard sizes of wire and cable, ins[illegible] for use fo[illegible] placements during the emergency. This material was ordered, in so far as possible, in standard sizes and voltages so that it could be made available to other systems.

In the President's directive, the Federal Power Commission was requested to maintain contacts with all vital national-defense industries to insure continuity of power supply, as well as adequate power supply for all defense needs. For those industries having their own generating plants this may involve interconnection with the central stations and their transmission systems; for those now connected with the utilities or purchasing all of their power supply, it may require reinforcing existing feeders, running a loop feeder into the customer's substation or a duplicate feeder to insure ample power supply and continuity of operation. The size of the load and the relative importance of the product in the war effort are the important factors in determining the lengths to which we should go in providing continuity of power supply to these industries.

In view of the fact that on many systems the available generating capacity and that now scheduled for installation this year and next will be insufficient to meet the war loads, the Commission, through its regional offices, has started a survey on each power system of the loads to be anticipated, power supply to different classes of consumers, and methods of reducing peaks and conserving energy, as well as of rationing power should that become necessary. This will also involve an analysis of the character of loads on each feeder and the preparation of a plan to be put into effect immediately for pulling switches on less essential loads should a breakdown of a generating unit or an entire generating station occur.

One phase of the Commission's work is the necessity of protecting existing equipment against all hostile acts. Several of the papers in the symposium emphasized the difficulty of securing new equipment for expansion or replacement. It is highly important, therefore, that existing equipment be protected against all hazards.

It has been found that most of the measures adopted prior to the entry of the United States into the War would also provide greater protection and reliability of service in peacetime. Protection during wartime, however, will require eternal vigilance during the emergency to prevent failures of equipment and to restore service as quickly as possible in the event of accidental failure.

As pointed out in Philip Sporn's paper, "Electric Power Distribution Systems in Wartime" (*Trans. '41, Mar. sec., p. 105–07*), it is inappropriate to discuss these protection measures in detail, but the Commission's staff has been and is now actively engaged in protective surveys and is carrying out joint inspections with the Army authorities having jurisdiction. This may appear to some of the utilities to be a duplication of the previous surveys made by members of the Commission staff. It must be remembered, however, that we are now actually at war and that additional protective measures will become necessary to meet the rapidly changing conditions in order to insure continuity of power supply and to maintain full war production.

THOMAS R. TATE (F'35)

(Formerly director, national defense power staff, and chief, bureau of electrical engineering, Federal Power Commission; now consulting engineer, Charles T. Main, Inc., Washington, D. C.)

NEW BOOKS • • •

Fundamentals of Radio. By E. C. Jordan, P. H. Nelson, W. C. Osterbrock (M'41), F. H. Pumphrey (M'25), and L. C. Smeby; W. L. Everitt (F'36) editor. Prentice-Hall, Inc., New York, 1942. 400 pages, illustrations, etc., 6 by $9^1/_2$ inches, trade price \$5, discount for schools.

Designed as a text to meet the requirements of the wartime program to train technicians for the armed forces, for industry, and for radio broadcasting, this book aims to cover the field of basic radio communication. The material is presented with a minimum of mathematics, necessary elements of which are briefly reviewed in the opening chapter, and is planned to train those who must maintain and operate apparatus rather than design it. Direct and alternating current, vacuum-tube theory and applications, wire telephony, audio systems, and frequency-modulation transmission are among the topics discussed.

The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.

These and thousands of other technical books may be borrowed from the library by mail by AIEE members.

All inquiries related to purchase of all books reviewed in these columns should be addressed to the publisher of the book in question.

Table of Natural Logarithms. Volume 4, Logarithms of the Decimal Numbers from 5.0000 to 10.0000. Prepared by the Federal Works Agency, Work Projects Administration for the City of New York. Published by the National Bureau of Standards, 1941, Washington, D. C. 506 pages, tables, 11 by 8 inches, cloth, \$2.

This last volume of a series of four contains the 16 decimal-place values of the natural logarithms of the decimal numbers from 5 to 10 at intervals of 0.0001. The three preceding volumes contained the 16 decimal-place values of the natural logarithms of the decimal numbers from 0 to 5 at intervals of 0.0001 and of the integers from 1 to 100,000.

Tin Solders: a Modern Study of the Properties of Tin Solders and Soldered Joints. (Research Monograph No. 1) By S. J. Nightingale. Second edition, revised by O. F. Hudson. British Non-Ferrous Metals Research Association, London, 1942. 117 pages, illustrations, etc., 10 by 6 inches, cloth, \$2.75.

The results of further investigations, chiefly on the creep properties of solders and soldered joints, are incorporated in this edition. The first section of the book deals with the constitution of the tin solders; their structure; the mechanical properties of the solder alloys; the strength of soldered joints; creep properties of solder alloys and soldered joints; and alloying between the solder and the joint members. The second part discusses such practical considerations as fluxes, spacing, wiped joints, and the choice of a solder.

Tables of Physical and Chemical Constants and Some Mathematical Functions. By G. W. C. Kaye and T. H. Laby. 9th edition. Longmans, Green and Company, New York, London, Toronto, 1941. 191 pages, tables, 10 by $6^1/_2$ inches, cloth, \$5.

Aims to fill the need for an up-to-date collection of physical and chemical tables which will meet the usual needs in teaching and laboratory work. The new edition has been thoroughly revised and expanded.

United States Tennessee Valley Authority, The Chickamauga Project. (Technical Report No. 6) Tennessee Valley Authority, Treasurer's Office, Knoxville, Tenn., 1942. 451 pages, illustrations, etc., $9^1/_2$ by 6 inches, cloth, \$1.

Facts concerning the planning, design, construction, and initial operations of the Chickamauga project of the Tennessee Valley Authority are presented. Unusual and unprecedented features and methods are described in some detail, while common procedures and practices are briefly treated. Chapter bibliographies, a section on costs, and a statistical summary are included.

Physics for Engineers. By Sir A. Fleming. Chemical Publishing Company, Brooklyn, N. Y., 1942. 232 pages, illustrations, etc., 9 by $5^1/_2$ inches, fabrikoid, \$3.

Attempts to summarize current knowledge in the realm of physics with special reference to the requirements of practical engineers. The fundamental physical units, various aspects of energy, electricity, electronic emissions, radiation, optics, sound, and atomic transformations are discussed.